Welding Engineer

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MAY, 1959

miller on-the-job welder/power plants

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A new convenience has been added to one of Miller's most copied original welder designs: Models AEA-200 and -200-L are now available with electric starters for their 12.9 hp Onan engines. All the other features of these 225 ampere, 100% duty cycle machines, which have earned a world-wide respect for rugged versatility, remain unchanged.

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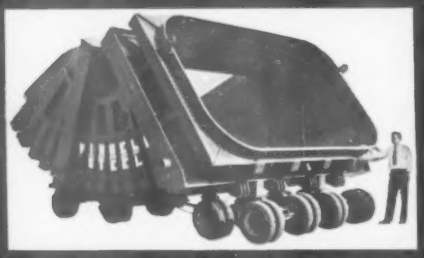
Huge flame deflector is of 1-inch plate V'd out 45° on both sides. P&H AP-100 (E6010) all-position electrodes were used to weld overhead and vertical joints — and DH-5 (E6024) for horizontal and flat fillets.



Completed unit weighs over 50 tons and is 16 ft. wide and 21 ft. high. Special house-moving dollies were required to truck it from Vinnell's Irwindale plant to the base 200 miles away.

giant ICBM flame deflector welded with P&H Iron Powder Electrodes

To weld the giant flame deflector for America's first operational ICBM base at Cooke Air Force Base, Calif., about 7000 lbs. of the newly developed P&H E6010 and E6024 Electrodes were used. Built by Vinnell Steel, the deflector helps to dissipate the terrific heat and thrust generated by the launching of mighty Atlas missiles.

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P&H Electrodes can cut your welding time, reduce electrode cost, and practically eliminate post-welding cleaning and chipping of weldments. Write for Bulletin R-29, which gives full description and specifications data. Address Dept. 306B, Harnischfeger Corp., Milwaukee 46, Wisconsin.

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11. **REINFORCED** welding and ground cable terminals.
12. **CONTROLLED COOLING** of all generator parts insures long, trouble-free life.
13. **250 AMP. HOBART BUILT GENERATOR** provides exceptional arc stability in all ranges—helps you do better, faster work under all conditions.

4. *The "MAINLINER" delivers a* HOT FAST ARC *with plenty of engine power*

...e "Mainliner" can't be beaten for fast, eco...mical field operations. Here two weldors ...am up to get a pipeline job done in half the ...me.

THE NEW "MAINLINER" is just one of the many Hobart welders that is designed to meet exacting requirements. An extremely wide variety of models in many capacities is available to exactly answer your welding needs.

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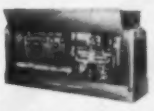

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300, 400, 600 amp. Gas Drive Welders

200 amp. DC "Husky Boy"

400, 600 amp. Self-Propelled "Big Wheeler"

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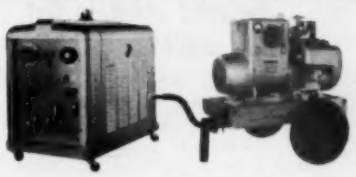

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Vol. 44—No. 5

The magazine of joining and severing materials

Welding Engineer

This is welding: May, 1959

A salute to the oil industry

Oil's first century—born in freedom, working for progress 27
In its first 100 years, the oil industry has advanced from Drake's 69½ ft well at Titusville to the world's deepest well, 25,340 ft, in Pecos County, Texas. The 1959 International Petroleum Exposition will commemorate the centennial this month.

Multi-station welding a money-saver when fabricating modern refineries 30
Chief welding engineer **C. H. Voelker** reports how multi-station welding eliminated some 200-ft cables, saved time and money when welding catalytic petroleum crackers.

Pipeline brings first natural gas to Florida 32
The oil and welding industries join forces to bring economy-building natural gas to Florida via more than 2,500 pipe-miles at a beginning rate of 282 billion cu ft daily.

Hardfacing drill bits—another contribution to the oil industry 35
Abrasive wear on rotary drilling bits because of their large diameters gives welding another opportunity to offer its know-how to the oil industry—this time in the form of hardfacing.

Another firm offers electron-beam welder to industry 40
In little more than one year this new welding process has advanced from the laboratory to commercial use. At present, 15 companies are involved in research and development, and six of these have units on the market.

New system eliminates CO_2 disadvantages 46
Weld spatter, loss of electrode elements, and high heat input were problems involved in welding mild and low-alloy steels with carbon dioxide as a shielding gas. With a pulsing arc, however, these disadvantages have been eliminated.

Extruded uranium welding wire proves best 58
Mig welding of uranium necessitated uranium wire. **E. L. Brundige, G. S. Hanks** and **J. M. Taub** discuss extrusion of this wire, which experiments proved to be the best fabrication method.

Also in this issue:

A welding and pipelining history 33
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Enter: welding, Exit: hard water 38
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Mixer blades induction brazed at a 1,200-per-hour clip 60

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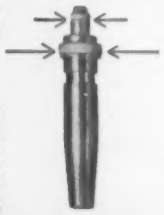

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Welding Engineer

America's pioneer publication which, combined with The Acetylene Journal, has been devoted to the interest of the welding and allied industries since 1898

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convert the **total** fluxed portion of electrodes into **weld metal.**
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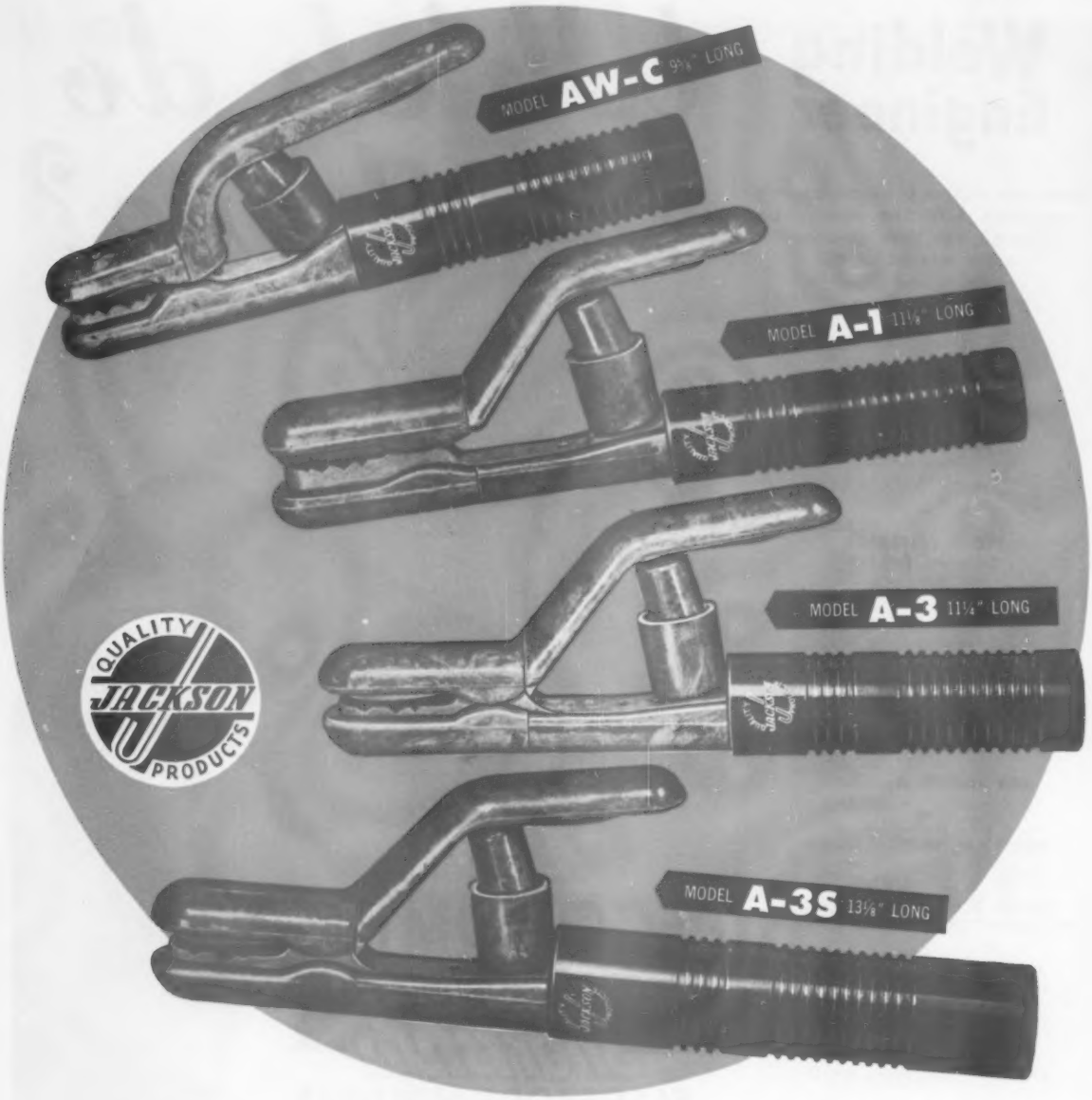

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Tongs of heat treated 98% copper alloy with high-impact, heat resistant glass fiber insulators permit highest duty cycles with a wide margin of safety.

For top production, select the holder best suited to the job at hand. The table at the right rates these holders by duty cycle, that is the percentage of arc time in any ten-minute period of work, depending on rod size, amperage and cable size.

Holder Class	Model	Electrode	Amps & Cable	Duty Cycle
Small	AW-C	7/32"	250-1 300-1/0	50%
Medium	A-1	1/4"	300-1/0 350-2/0	50%
Large	A-3	3/8"	375-2/0 450-3/0	65%
Heavy-Duty	A-3S	3/8"	500-4/0	80%

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25 awards presented at opening of AWS convention

Ten national and 15 regional awards were presented at the opening session of the 40th Annual Meeting of the American Welding Society at the Hotel Sherman, Chicago.

Dr. Ernest F. Nippes, Prof. of Metallurgical Engineering and director of welding research, Rensselaer Polytechnic Institute, Troy, N. Y., was presented the Samuel Wylie Miller Memorial Award. The award is given to the person who has made outstanding contributions toward the advancement of welding and cutting.

Honorary membership to AWS was conferred upon James F. Lincoln, chairman of the board of the Lincoln Electric Co., Cleveland.

The 1958 Lincoln Gold Medalist is Alexander Lesnewich, Air Reduction Research Laboratory. This award, donated by Lincoln Electric Co., is given to the person whose paper published in *The Welding Journal* during the past year, is judged the best. Lesnewich's paper was "Control of melting rate and metal transfer in gas-shielded metal-arc welding."

Harry W. Pierce, vice chairman of the board of the New York Shipbuilding Co., was presented the National Meritorious Service Award. This is given for outstanding service to the AWS.

A. F. Davis Silver Medals were awarded to John Mikulak, Worthington Corp.; K. H. Koopman, Pressure Vessel Research Committee of the Welding Research Council; and L. V. LaRou, Wall Colmonoy Co.

Davis Medals are awarded to authors of papers contributing the most to the progress of welding in the fields of structural and machine design.

This year's Adams Lecturer, C. E. Jackson, Linde Development Laboratory, was presented with a certificate and honorarium when he presented his paper, "The science of arc welding."

Hiram Brown of Solar Aircraft Co. was presented the Educational Lecturer Certificate Award. This award recognizes outstanding contributions to the National Educational Program in presenting lectures at the annual spring meeting.

The final national award was the presentation of the Past President Certificate to G. O. Hoglund, head of the welding section of the Alcoa Process Development Laboratory, whose term as AWS president expires at the end of this month.

District Meritorious Certificate Awards are given to recognize those who have performed some definite or unusual service to a section, district or to the AWS.

Such awards were presented to I. W. Johnson and O. C. Frederick, General Electric Co.; C. L. Kreidler, Lehigh Structural Steel Co.; G. E. Claussen, Arcrods Corp.; L. H. Hawthorne, Revere Copper & Brass Inc.; D. H. Marlin, Cravo Corp.; A. E. Pearson, Ingalls Iron Works; R. B. McCauley, Ohio State University; E. R. Benedict, Ricwil-Co.; K. Sheren, Taylor-Thompson Machinery Co.; O. T. Barnett, Armour Research Foundation; J. B. Welch, Cutler-Hammer Co., and G. Garfield, Research Welding & Engineering Co., Inc.

The Neitzel Award is presented to the AWS chapters having the greatest net numerical increase in membership over the past year. The Providence, R. I., and Olean-Bradford, Penn., sections received this award.

All-State Alloys opens St. Louis warehouse

All-State Welding Alloys Co., Inc., White Plains, N. Y., has opened a Central Warehouse at 1523 N. Broadway, St. Louis. The warehouse will stock all company alloys and fluxes.

Establishment of the new facility will provide distributors within a 400-mile radius of St. Louis with one-day service. Distributors in the Midwest and southwest will also receive faster service than before.

David N. Coombs, formerly with Mid-West Tool & Supply Co., is branch manager of the warehouse.

NEWS

Linde plant nears completion

PITTSBURG, Calif., oxygen-nitrogen plant being built by Linde Co., New York City, is nearing completion. Here, two cranes position an 18,000-lb aluminum hemisphere. It will be welded to an identical unit, positioned below, to form inner shell of 25,000,000-cu-ft liquid nitrogen storage tank. Insulation will be added and enclosed by steel outer-shell. Plant, first section of which will soon begin operation, will eventually produce 300 tons of liquid oxygen and nitrogen a day while serving a nine-state area.

Zirconium Association formed by 16 companies

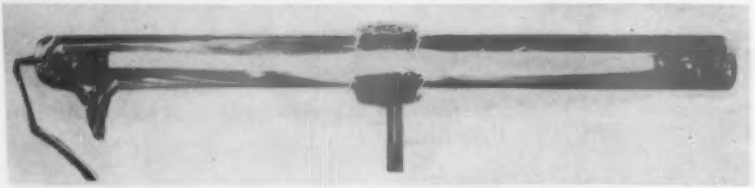
Sixteen firms that produce, melt and process zirconium have formed the Zirconium Association, with main offices at 2130 Keith Building, Cleveland. Executive director of the Association is W. B. Thomas, Thomas Associates.

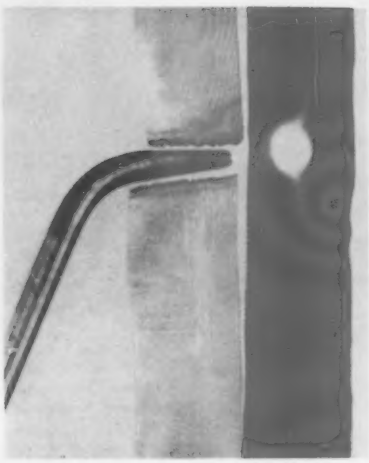
The following firms started the Association: Calumet & Hecla Inc.; Carborundum Metals Co.; Carpenter Steel Co.; Columbia-National Corp.; Copperweld Steel Co.; Damascus Tube Co.; Firth Sterling Inc.; Harvey Aluminum Co., Inc.; Jessop Steel Co.; Mallory-Sharon Metals Corp.; National Lead Co.; Oregon Metallurgical Corp.; Superior Tube Co.; Tube Reducing Corp.; Universal-Cyclops Steel Corp.; Wah Chang Corp.

Cleveland distributor top Hobart representative

Wolfenden Welding Supplies Inc., Cleveland, for the fourth consecutive year is the top volume distributor for Hobart Bros. Co., Troy, O. The company was recently presented the Hobart volume award for 1958.

Second top distributor is Roy Smith Co., Detroit, and third, H. K. Miller Inc., Chicago.





NATIONAL Carbon Co., Div. of Union Carbide Corp., has developed new way to convert textile forms directly to graphite with a purity said to be in excess of 99.9%. Patents have been applied for process in which fabrics such as rayon are graphitized by electrically heating to temperature approaching 5,400 F. In thermo-chemical conversion, crystalline structure of material is changed to that similar to manufactured graphite used for electric furnace electrodes, nuclear reactor structures, etc. Material can be applied to myriad of uses, says manufacturer. Possible applications include use as reinforcement of plastics, such as those used in missile nose cones, and in resistance heating elements so high temperatures can be applied exactly where wanted. In top picture, graphite cloth's electrical conductivity and thermal stability at high temperatures are demonstrated in vacuum glow tube. Cloth attains white heat when operated on 110 volts. Incandescent strip radiates 1,300 watts. At left, torch test on cloth (right) and stainless steel. Melting action on stainless, and absence of such action on cloth, is shown. Graphite has no melting point and sublimes at 6,600 F. At right, 1-in. strip of cloth 40 in. long is wrapped around beaker to illustrate resistance heating properties in applying heat where wanted. Water quickly boils when 700-watt demonstration unit is connected to 110-volt circuit.

COMING EVENTS

MAY 4-6: NWSA Annual Convention, Fairmont Hotel, San Francisco.

MAY 5-6: Canadian Welding Society, Second Annual Welding Convention, Exhibition Park, Toronto.

MAY 5-6: Canadian Welding Society, Welding Show, Exhibition Park, Toronto.

MAY 20-22: Society for Experimental Stress Analysis Spring Meeting and Exhibition, Sheraton Park Hotel, Washington, D. C.

MAY 25-28: Design Engineering Show and Conference, Convention Hall, Philadelphia.

MAY 25-27: Annual Convention and Industry Production & Quality Control Exposition, Public Hall, Cleveland.

JUNE 4-5: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.

JUNE 15-26: Ohio State University Summer Course on Fundamentals of Welding Engineering. Sponsored by Dept. of Welding Engineering, Columbus.

SEPT. 28-OCT. 1: National Fall Meeting of the AWS, Detroit.

NOV. 2-6: 41st National Metal Exposition and Congress, International Amphitheatre, Chicago.

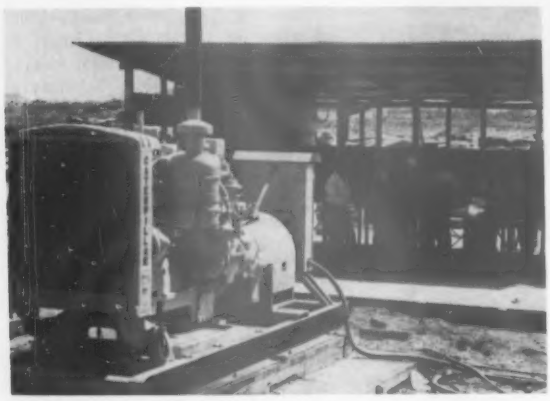
IAA elects McBurney as new president

The International Acetylene Association elected L. L. McBurney president at its recent New Orleans convention.

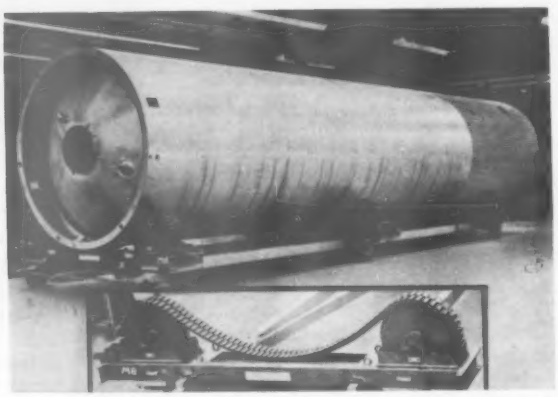
Other officers elected were J. L. Adank, National Cylinder Gas Div., as vice president; L. G. Mathews, Linde Co., as secretary, and R. A. Speck, National Carbide Co., as treasurer.

McBurney, president of Smith Welding Equipment Corp., Minne-

(Continued on page 75)



DIESEL-electric units such as one above furnished power for battery of Lincoln Electric Co. welding generators during construction of oil refinery for International Petroleum Ltd. at Mamonal, Columbia. Seven similar units were used to power welders on job which involved building 26,000 bbl refinery. Construction was handled by Compania Bechtel, Cartagena. Here, some of 1,100 Columbian natives used on job (under shelter) are given qualification tests for pipe welding in the field.



U. S. Army Ordnance Michigan Missile plant, operated by Missile Div. of Chrysler Corp., uses Aronson Machine Co. Rubber Trac-Treds installed on special dollies to prevent damage to thin aluminum skin of Redstone and Jupiter missiles during welding and X-ray inspection. Two double treds are staggered at either end of dolly, single tred is used in middle, providing constant support to skin's surface. Driver unit in middle provides turning power. (See *Army's Jupiter and Redstone missiles . . .* p. 42, April.)

24 Pages *of interesting data on cylinder manifolds* • • •

This 24 page catalog (our Form 14) offers a beautifully illustrated description of the COMPOUND PRESSURE cylinder manifold for industrial and medical cylinder gases. There are no solder joints, and the entire cylinder manifold may be assembled or disassembled with the use of two open-end wrenches. All assembly parts can be carried in stock and the parts are so designed that they permit prompt assembly of cylinder manifolds of every useful capacity; "wall type, stand type with center sections for one or more regulators, for manual or automatic changeover." The COMPOUND PRESSURE cylinder manifold is the sturdiest, the safest and the most attractive one your money can buy, and its price is very little more than that of ordinary manifolds. If you are interested in cylinder manifolds,

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With continually increasing fabrication costs, you can't afford a *margin for error*. Successful fabricators specify the inherent qualities of all position iron powder low hydrogen Atom Arc electrodes to reduce the unnecessary rework that chews up profits and delays jobs.

Inspection by X-ray is a requirement for most fabrications involving low alloy or high tensile steels. There is an Atom Arc alloy with the right physical properties and chemistry for welding most low alloy or high tensile steels. An electrode that deposits X-ray sound weld metal, increases the efficiency of your welding operation and lowers your costs. For complete details write for the "Handbook for Welding Low Alloy High Tensile Steels," Alloy Rods Company, Dept. 02, P. O. Box 1828, York, Pennsylvania.

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Atom Arc 8018 N
AWS-E8018-C2

Atom Arc 8018 CM
AWS-E8018-B2

Atom Arc 9018 CM
AWS-E9018-B3

Atom Arc 10018 MM
AWS-E10018-D2

Atom Arc 12018 NMV
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- **Victor Equipment Company**

DISTRICT OF COLUMBIA
- **Southern Oxygen Company**

GEORGIA
- **Southern Oxygen Company**

ILLINOIS
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

INDIANA
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

KENTUCKY
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

LOUISIANA
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

MARYLAND
- **Southern Oxygen Company**

MASSACHUSETTS
- **Charles Peirce Associates**

MICHIGAN
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

MINNESOTA
- **C R O Engineering Company**

MISSOURI
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

NEW JERSEY
- Cranford
- **Harris Calorific Sales Inc.**

NEW YORK
- Buffalo
- **General Dynamics Corporation**
- **Liquid Carbonic Division**

OHIO
- **Burdett Oxygen Company**

OREGON
- **Industrial Air Products Company**

PENNSYLVANIA
- Philadelphia
- **Southern Oxygen Company**
- Pittsburgh
- **Weld Tooling Corporation**

TENNESSEE
- **Southern Oxygen Company**

TEXAS
- Fort Worth
- **Big Three Welding Supply Company**
- Houston
- **Big Three Welding Equipment Co.**

VIRGINIA
- **Southern Oxygen Company**

WASHINGTON
- **Industrial Air Products Company**

WISCONSIN
- **C R O Engineering Company**

REGIONAL REPRESENTATIVES

NORTHEAST
- **Henry Keep, Jr.**
- **New York, N.Y.**

CENTRAL
- **R. W. Kleine**
- **Milwaukee, Wisconsin**

SOUTHERN
- **Paul M. W. Bruckmann**
- **Mobile, Alabama**

WESTERN
- **W. S. Johnson**
- **Monterey, California**

WELDING ENGINEERING · Messer · SINCE 1898 ·

Messer Cutting Machines, Inc.

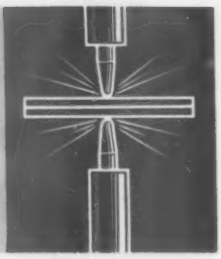
CHRYSLER BUILDING · 405 LEXINGTON AVENUE · NEW YORK, N.Y.

P R MALLORY & CO. Inc

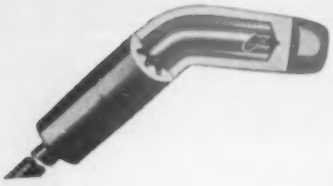
MALLORY MEMOS

NEWS AND TIPS ON RESISTANCE WELDING

P. R. Mallory & Co. Inc., Indianapolis 6, Indiana



WELDING HINTS

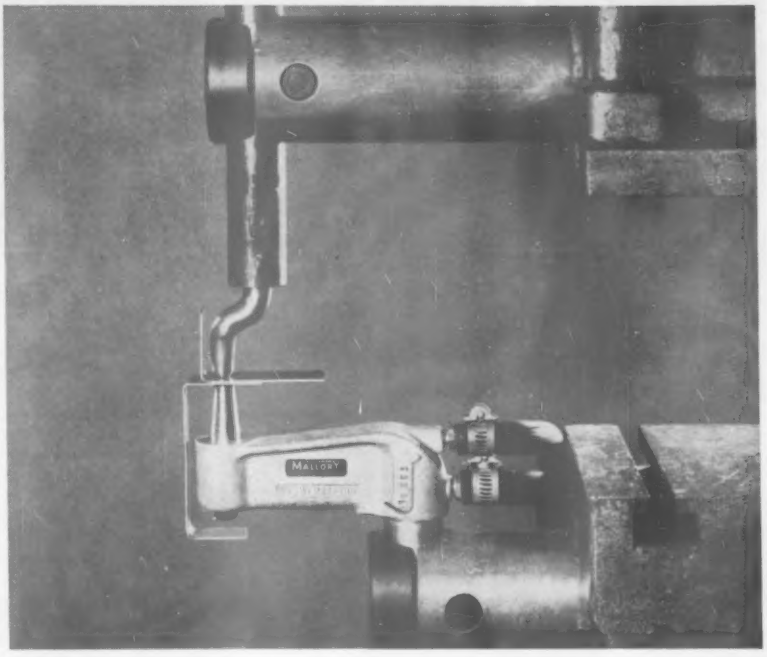


Cooling tubes in holders should be adjusted to extend within ½" of the end of the hole in the electrode, to get correct flow in the electrode. (Mallory bent electrodes have cooling tube bent in place*, to make sure water flows all the way to the tip.)

**U.S. Patent 2,489,993*

Choose electrode size. Don't use small electrodes on heavy gauge work, or large tips on light gauge stock.

Write for this wall chart of "Do's and Dont's of Resistance Welding."



Tricky welding set-ups? Solve them with MALLORY standard electrodes!

Maybe you've always figured you need custom-designed electrodes to make welds in tight corners, on inside joints and other difficult locations. Before you go to the extra cost and delivery delay of "specials", see the broad range of unusual electrode shapes that you can get as standard models from Mallory.

The Mallory standard line includes 51 different irregular shape electrodes . . . single bend, double bend, offset . . . in a range of sizes and alloys. You'll probably find exactly the size and shape you need for that special job. You'll get it immediately. And it will be far more economical than a tailor-made electrode . . . far more serviceable than one you might bend or braze together in your own shop, because it's made of Mallory alloys by advanced Mallory production methods.

You'll find the most complete range of electrodes in the Mallory standard line . . . 113 different Straight electrodes with various tip designs . . . 30 different Elkonite®-faced electrodes . . . 10 different socket types . . . 37 different threaded electrodes. Many are available with the Mallory fluted cooling hole for long life.

Mallory welding products are available from authorized distributors located in all principal cities.

Having regulator headaches?
...END THEM NOW!

K-G distributors everywhere are having a

REGULATOR ROUNDUP

...to put the outstanding line of K-G regulators to work for you

We're trading high... and giving you an UNCONDITIONAL 2-YEAR GUARANTEE

Get all the dollar-saving facts... use the Reader Service Card

Now's the time!

to standardize on the K-G equipment company, inc.

an Air Products subsidiary Allentown, Pa.

quality welding and cutting equipment since 1914

MAIL COUPON

K-G Equipment Co., P. O. Box 512, Allentown, Pa.
Please send me the name & address of my K-G Distributor.

Name.....

Company.....

Address.....

This cracked iron housing begged for retirement

But it was hard for the company to comply when they found a new pump housing would cost $1800, would take 90 days for delivery, and would lay off 40 men during the shutdown.

So they sent it over to Lawton-Schrader, a welding company in Richmond, Virginia to see if it could be repaired. Their weldors said it could be *permanently* repaired with Ni-Rod* "55" Electrodes. And they did it. All it took was 8 hours, 5 passes, and 23 pounds of Ni-Rod "55" Electrodes which also eliminated the need for preheat and postheat.

Back on the job in 1½ days, this pump housing is expected to last till the pump wears out. And the total cost came to $384, a saving of over $1400.

Good to keep in mind and on hand

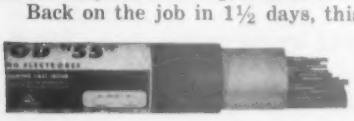
The example above brings out two good points. One . . . it's a good idea to keep Ni-Rod "55" in mind for emergency repair of cast iron parts. Two . . . it's even a better idea to keep a supply on hand to meet these emergencies when they come up.

Ni-Rod "55" makes permanent repairs possible with a minimum of time lost, and with a minimum of effort and money spent. It offers you a practical way to salvage defective castings and to join cast irons to other metals. It's ideal for building up worn or undersized areas. Machinable Ni-Rod "55" deposits give service as good or better than the original metal. And in 9 out of 10 cases, no preheat or postheat is needed.

Booklet gives complete data

"Repair Cast Iron Parts Quickly and Easily" tells the Ni-Rod "55" story in detail. It's yours for the asking. Write: *Registered trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.



INCO WELDING PRODUCTS
ELECTRODES • WIRES • FLUXES

WELDING ENGINEER

Your May, 1959

Weld World

As WE went to press, these were the industry's latest developments:

. . Last month's Welding Show in Chicago drew 11,241 registrants, while the meeting had a registration of 1,508 persons. The former figure is just shy of the record established in Philadelphia two years ago.

. . Among developments at the Chicago AWS Show was the formal organization of the Automatic Welding Machinery Association. Headquarters will be in Cleveland.

. . Worthington Corp. took the show as the occasion to award Distributor Service Plaques to two of its distributors. Awards were accepted by R. L. Kohlbry for Machinery & Welder Corp., Chicago, and Ray Tarbell for Scott-Tarbell, Inc., Cleveland.

. . Odds are about even that steelworkers will strike. Welding activities should not be affected too greatly unless strike lasts longer than six weeks—after which general shortages will become evident. If you're stockpiling steel, remember to stockpile electrodes and other welding materials.

. . Explosive cutting is the nearest approach yet to acetylene chalk (suggested in January, 1956 by WE) for high-speed severing of metals. It's not expected to replace oxyacetylene cutting, but should do well for tricky jobs. Du Pont developed the explosive.

. . Use of shaped (other than round) wires is among the newer theories in arc welding. It's supposed to improve the placement of weld metal."

. . Electric blankets for brazing will materially reduce costs of joining honeycomb structures. Blanket has network of wire-mesh heaters inside high-temperature silica insulation. It offers advantages in brazing large pieces, irregular shapes, and easily-distorted pieces.

. . New resistance-welding method developed by Primeweld Corp., Dearborn, Mich., is said to allow you to join fastening devices to stainless steel without weld discoloration.

. . Copper was cut in mid-April to 32 cents per pound, after a steady rise in recent months. Reason: dwindling orders.

. . Rumors continue to beset the welding industry: The latest: that Alloy Rods Co., York, Pa., was to be absorbed by a billion-dollar firm. "Nothing to it," says President E. J. Brady, "Alloy Rods is in business to stay. It is not for sale now . . . nor in the foreseeable future."

Longer runs
pay off in resistance welding, too!

For more mileage between dressings, use AMPCO-WELD® Electrodes

Send for catalog, price list, and name of your distributor

AMPCO METAL, INC., DEPT. 187E, MILWAUKEE 46, WISCONSIN
WEST COAST PLANT: BURBANK, CALIFORNIA
SOUTHWEST PLANT: GARLAND (DALLAS COUNTY), TEXAS
RW-26

30 YEARS AGO

(Taken from the WELDING ENGINEER of May, 1929)

—30 YEARS AGO—

An editorial asks "Should colleges teach welding?" Figures gathered from industry back argument that it should be.

—30 YEARS AGO—

A. M. Candy, Westinghouse Electric & Mfg. Co., spoke on the importance of arc welding at a Chicago AWS section meeting.

—30 YEARS AGO—

Electric Boat Co. reports its Groton, Conn., works is being equipped to build all-welded ships.

—30 YEARS AGO—

A recent symposium at Lehigh University, Bethlehem, Pa., included talks by R. D. Thomas, R. D. Thomas Co.; R. S. Donald, Thomson Spot Welding Co.; and J. H. Deppeler, Metal & Thermit.

—30 YEARS AGO—

On May 1, the Chicago and Central Div. offices of Union Carbide & Carbon Corp. moved into the new 40-story Carbide & Carbon Building, Michigan Ave. and S. Water St., Chicago.

—30 YEARS AGO—

Welding Engineer's staff was treated to a demonstration of the oxyacetylene welding and cutting torch when some piping repairs had to made in its home office building.

—30 YEARS AGO—

The Gas Products Association will hold its summer meet at the Golfmore Hotel, Grand Beach, Mich., June 20-22. E. L. Mills, Bastian-Blessing Co., is preparing a golf program.

—30 YEARS AGO—

Victor Welding Equipment Co. reports a 300% sales increase for the past year. Its president, L. W. Stettner, is visiting Europe.

—30 YEARS AGO—

Halpin & Kohlbry, formerly of 29 S. Fourth St., has moved to offices at 4116 Clayton Ave., St. Louis.

—30 YEARS AGO—

F. C. Heppel is president of the new Modern Engineering Co., Memphis.

—30 YEARS AGO—

Smith Welding Equipment Corp. is adding to its plant at 2619-33 Fourth St., S. E., Minneapolis.

New design in Sigma hand welding torches

Here is a new, lightweight torch—only 16 ounces—for manually welding light-gage steels. Sigma ST-2 welds in all positions with no change in control or current settings. Welds .030- to .100-in. sheet, using low-voltage short-arc technique with .020- and .030-in. hard-drawn wire. For 200 amp continuous service, a-c or d-c.

Balanced design makes handling easy. Service lines enter through rear of handle—a convenience in cramped quarters. Start-stop switch on handle, easy to reach. Nozzle has a 60° curve for maximum weld visibility.

Sigma ST-2 makes high-quality welds at high speed. Seams require no cleaning . . . distortion is at a minimum. Inert gas shielding is economical. Low flow rate—only 10 cu. ft. or less per hour—means even more savings.

Call your nearest LINDE office today for a demonstration of this new Sigma ST-2 torch! Or write Dept. WE-5, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde TRADE-MARK

UNION CARBIDE

"Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

THIS HELPS MAKE THE DIFFERENCE

*CYNOSURE

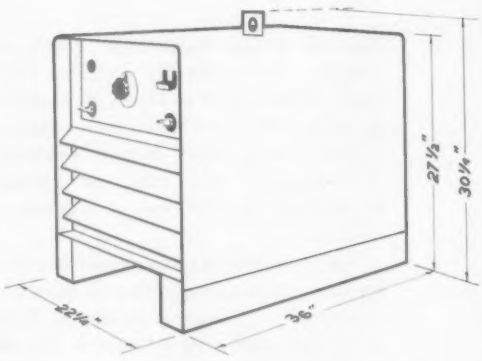
THAT MAKES the Miller GOLD STAR SR the GREATEST . . .

. . . rectifier type welder ever created!

Small illustration above shows the Miller-designed, Miller-built semi-metallic rectifier stack that combines with a new transformer and new weld stabilized circuit to set the Gold Star SR line of welders above and apart from all others; that has earned for them the reputation among professional weldors of being the world's best performing, longest lasting machines of their type.

Built to withstand the most demanding industrial d-c welding applications, including carbon arc service, this series is available in four basic models with 60% duty cycle ratings of 200, 300, 400 and 600 amperes. Duplex models to 1200 amperes. Shown to right is line drawing of the "horizontal" model for use where space is limited, or for outdoor use.

Complete particulars will be sent promptly, or a demonstration by your local distributor will be arranged at your convenience.

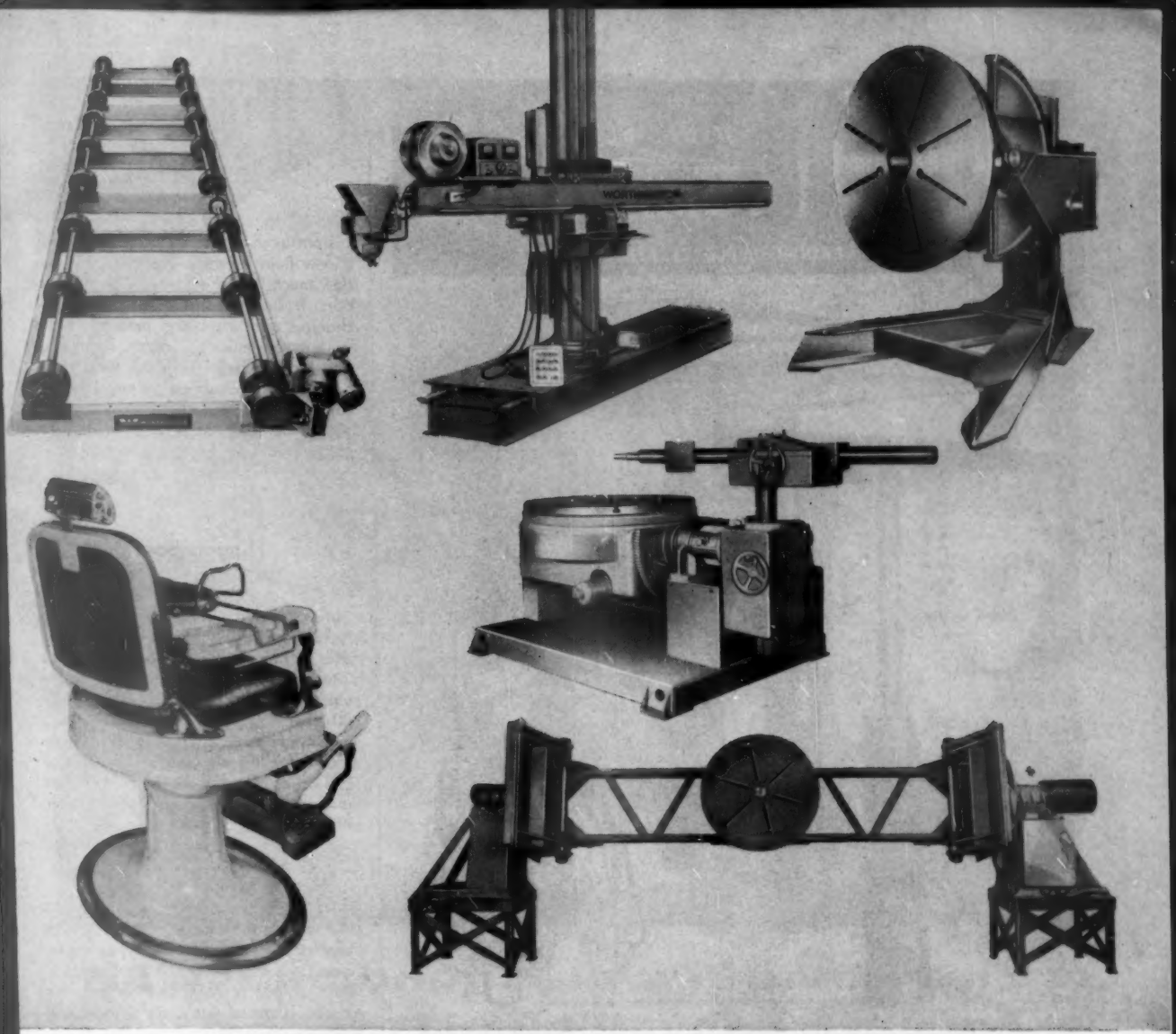


miller ELECTRIC MANUFACTURING COMPANY, INC.

APPLETON, WISCONSIN

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal
EXPORT OFFICE: 250 West 57th St., New York 19, N. Y.

CYNOSURE: Anything to which attention is strongly turned; a center of attraction.



WHICH ONE OF THESE POSITIONERS DOESN'T WORTHINGTON MAKE?

Of course, Worthington doesn't make barber chairs. We really don't know anything about cutting hair . . . *but,* when it comes to positioning for welding, that's where we're right at home.

Whether you're talking about a small positioner for automatic welding of a sub-assembly, a 400-ton turning roll for a nuclear reactor, or a completely integrated push button package, Worthington is ready and able to serve you.

You owe it to yourself to investigate the profit-producing possibilities of positioning equipment—especially in these days of steadily rising labor costs and tight work scheduling. You get faster production, better and smoother welds, fewer accident hazards and less need for crane service. Every piece of Worthington positioning equipment is job-rated for extra capacity, easy installation, greater parts interchangeability and economical operation. And you can count on equally complete Worthington engineering service . . . before you buy, during installation, right through regular maintenance. Why not ask your nearest Worthington distributor or District Sales Office for more information on profitable positioning equipment. Worthington Corporation, Section 55-7, Plainfield, N. J. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON . . . FIRST IN POSITIONING FOR WELDING

WORTHINGTON

ATLAS | WIDE - BLADE TOMAHAWKS

WORLDS LEADING WELD CLEANING TOOLS

for the welder who thinks he has everything!

NEW! "SUPER" TOMAHAWKS

Get these SUPER features in the new "SUPER"!

1 Redistribution of weight—The weight's in the head for more production with less effort.

2 New light weight, tempered aircraft aluminum shaft. Unbendable—unbreakable. Can't turn or come loose.

3 New Atlas "wide-blade" design. Wider chipping edge further increases chipping speed—adds to life of tool.

4 Formed hardwood grip that fits the hand. Locked on shaft so it can't turn or loosen.

Tough as they come!

33 MODELS

Each Atlas tool is made as well as we know how. Ask your welding supply dealer to show you the complete line.

ATLAS WELDING ACCESSORIES INCORPORATED
707 E. LEWISTON
FERNDALE 20, MICH.

Letters . . .

Bids adieu

Sir: *Preston, Ontario*

I am leaving the welding industry for a new field of work. I wish to tell you how much I have enjoyed your publication. It has kept me up on current changes and ways and means. I have liked it very much . . . again, thank you for the wonderful articles; they have been a real education to me. I would not want to be without *Welding Engineer* as long as I was in the industry . . .

K. J. Sager

Higgins boat

Sir: *Long Island City*

In your March, 1959, issue you conclude the article "Mig welding fabricates a unique hull bottom," with the statement " . . . the entire job consumed 40 cylinders, each holding 2,600 cu ft."

I am interested in knowing what type of cylinder this was that held 2,600 cu ft. of argon. Most of the argon cylinders currently used in the industry contain only 330 cu ft.

Edward R. McRedmond
Air Products Inc.

—There are liquid oxygen and argon cylinders on the market that hold such large amounts of gases. For example, Linde Co.'s LC3 holds the equivalent in liquid oxygen of 3,000 cu ft. of gaseous oxygen. Likewise, this same cylinder will hold the liquid argon equivalent of approximately 2,900 cu ft of gas. Although this is true, we checked with the sources of the article and found that the information provided us contained an error. Where it stated that 104,000 cu ft of argon was used on the job, it should have read 10,400 cu ft of argon.

Safety award

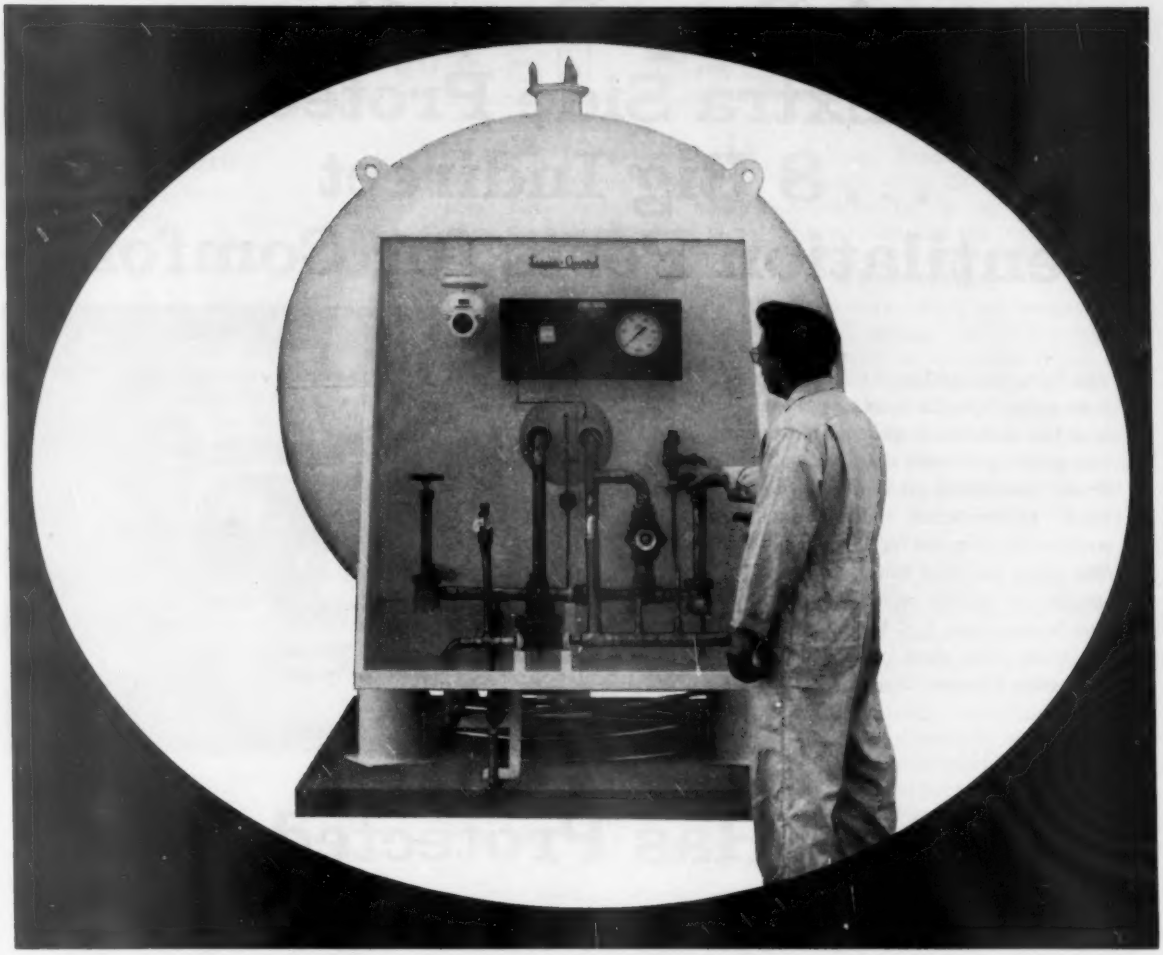
Sir: *Chicago*

It is my pleasure to inform you that your publication has been voted the National Safety Council's Public Interest Award for 1958.

We here at the Council know all you have been doing for safety. . . .

I am sure you feel, as we do, that there is another dividend as a result of your safety efforts—the knowledge that you have helped prevent many accidents. Many thanks for your support.

Howard Pyle, President



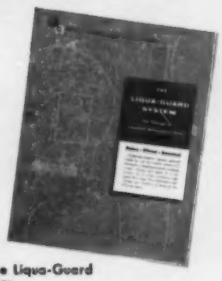
NEW! Cambridge Liqua-Guard Design for Modern Liquid Oxygen Systems

Cambridge Company, working with your gas supplier, offers a greatly simplified method for storing and handling atmospheric gases. A single outside reservoir stores oxygen, nitrogen and argon in liquid form.

This is truly the modern concept for gas handling and gives you important cost and handling advantages:

- Delivers 100% product volume, no residual gas loss
- Eliminates large numbers of high pressure cylinders
- Reduces handling, labor, cuts storage space
- Eliminates need for high pressure regulators
- Reduces accidents to personnel and property damage from cylinder handling

The Liqua-Guard System features a complete line of vacuum jacketed vessels, vaporizers and associated equipment. Ask your gas supplier for a site survey.

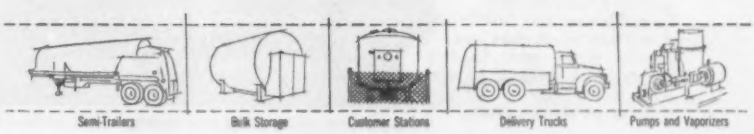


Send for Bulletin CS19 on Cambridge Liqua-Guard System for Liquefied Atmospheric Gases.

CAMBRIDGE COMPANY

4 INDUSTRIAL AVE., LOWELL, MASS.

a division of Carrier Corporation



CC9-6

A Deep Deep Cup for Extra Side Protection ... 8 Big Indirect Ventilation Ports for Comfort!

This light, comfortable, flexible mask goggle is American Optical's latest for welders. The large face mask and deeper cup not only provide greater protection than ever but easily fit over prescription glasses. Lens adapter is black, flame-resistant nylon. Takes our standard lens ring and regular 50 mm. round filter lenses and cover lenses. Rings and lens adapter are quickly replaceable. Noviweld filter lenses, shades 3, 4, 5, 6 protect against dangerous rays, glare, sparks and scale. Companion Chippers' Goggle is No. 489A.

It Has Protected Tens of Thousands of Eyes!

Over the years, this favorite has protected the vision of many a welder from the hazards of light rays, sparks and metal splashes. Side shields are engineered for ample (indirect) ventilation while fogging is controlled. Individual eyecups shaped to fit each eye are low set for wide vision. They won't conduct heat. Insulated ball-chain bridge is quickly adjusted. One-piece rubber headband. 50 mm. Noviweld or Filterweld lenses, shades 3, 4, 5, 6 or 8. Or Noviweld-Didymium lenses, shades 3, 4, 5, 6 for absorbing yellow sodium flare.

NOTE: Keep 'em clear with SUPER-CLEAR! AO350AF Super-Clear Lens Cleaner and Anti-Fog Fluid keeps glass and plastic clean and fog-free longer. Just spray it on and wipe it off. Test it and you will accept no substitute.

YOUR NEAREST AO SAFETY PRODUCTS REPRESENTATIVE CAN SUPPLY YOU

American Optical COMPANY
SAFETY PRODUCTS DIVISION

Always insist on Trademarked Safety Products

SOUTHBRIDGE, MASSACHUSETTS *Safety Service Centers in Principal Cities*

BETWEEN PASSES

the oil industry

Since this May issue of WELDING ENGINEER is devoted to the oil industry, which is celebrating its centennial, we'd like to quote Ray Kolb of Standard Oil Co., Whiting, Ind., on the importance of welding to this industry:

"Welding has been closely allied with petroleum refining as we have advanced from the early Burton Stills to our modern Ultraformers. As early as 1910, Dr. W. M. Burton was calling for elevated temperatures at operating pressures of 75 to 95 psi, a combination which was too much for riveted seams to hold without serious leakage. This was our first great problem for welding to solve, but it proved to be only the forerunner of many others. Since then, our pressure requirements have gone over 10,000 psi in some cases. Also, it has been necessary to weld many different metals, including carbon steel, all types of stainless steels, and many alloys of copper. Today it is difficult to imagine what a petroleum refinery would look like without welding. Everywhere we look there are welded tanks, stacks and machinery parts. In fact, it is almost impossible to look in any direction without seeing welding applications in useful refinery service. . ."

mild complaint

We are always happy to see welding portrayed in advertising, since it helps WELDING ENGINEER fulfill its purpose in life—the advancement of the process. However, we would like to take mild exception to an award-winning advertisement that recently was reproduced in the advertising trade publications. This ad, aimed at the construction industry, depicts a weldor joining corrugated steel sections with a stick electrode. But the electrode is being gripped by the holder halfway down the former's length. The picture clearly shows it is a *coated* electrode; nevertheless, the flash of an arc is shown—obviously faked.

Nothing in the ad would have been hurt by picturing correct procedure. Let's move that holder back to the bare end of the electrode!

test sites needed

The high alloys committee of the Welding Research Council is presently conducting extensive field corrosion tests to determine what industrial process media cause intergranular attack of austenitic stainless steels. To accomplish this, several hundred corrosion test racks containing welded and unwelded specimens with a variety of heat-treatments have been prepared. Two series of test racks, measuring 4 by 4 by 12 in., are being used. One contains molybdenum-bearing alloys (types 316, 317, etc.), the other, moly-free alloys (types 304, 310, etc.).

The results of this program should permit a more accurate description of the types of media which cause intergranular corrosion. Also, they will be used to check the boiling 65% nitric acid test as a method for predicting such corrosion susceptibility.

A search for industrial exposure sites is now in progress. Specifically, media which have produced intergranular failure of stainless steel components are most desirable. Those interested in participating in this study are invited to submit a description of the exposure site to:

R. M. Fuller
The International Nickel Co.
67 Wall Street
New York 5, N. Y.

Specific process details are unnecessary, but a description of solution composition and the local exposure conditions will be required. Upon completion of the exposure, each cooperating group will receive a detailed evaluation of the test results.

speaking of studies . . .

A basic research program aimed at improving the design and efficiency of nuclear boilers and other pressure vessels is underway at Southwest Research Institute, San Antonio, Texas. The work is jointly sponsored by the Atomic Energy Commission and the pressure vessel research committee of the Welding Research Council.

Pressure vessels are weakest at their openings, and it has been customary to overdesign them to provide a generous factor of safety since there is not enough basic information available to set minimum safety design requirements.

This study should provide that knowledge. The program will have three avenues of approach:

1. Static analysis of the stress distribution around openings.
2. Changes due to initial cycling.
3. The determination of plastic fatigue for a variety of nozzle configurations.

Experimental stress analyses will be made of specially designed vessels made from three different steels —ASTM A-201 and A-302 and U. S. Steel's Carriloy T-1. Plastic fatigue studies will be conducted at pressures up to 10,000 psi.

safety award

Again WELDING ENGINEER is a recipient of the National Safety Council's Public Interest Award "for exceptional service to safety." The non-competitive award is made annually to public information media, and the announcements made last month concerned awards for 1958.

"Of course I want you to think of suggestions. I just don't want to hear them."

Lincoln

WELDYNAMICS

NEWS ABOUT ARC WELDING AT WORK CUTTING COSTS

Four foot, ¼" box beam is positioned, welded and cleaned in 2½ minutes. Lincolnweld with Twinarc welds at 90" per minute.

TWINARC SIMPLIFIES WELDING... UPS FARM MACHINE PRODUCTION

The Krause Corporation has increased production on box beams 33% with their Lincolnweld Automatic welder by adding a Twinarc attachment. This company in Hutchinson, Kansas, makes one-way plows, wheel-mounted disc harrows and chisels, self-propelled forage harvesters and other farm equipment.

The Twinarc attachment feeds two welding wires through a single submerged arc welding head, doubling the speed of welding with a single wire.

Krause fabricates the box beams from ¼" angles. The angles are put in a jig, clamped in position with hydraulic positioners. The Twinarc makes one pass on each of the two edge seams at 90 inches-per-minute.

Mr. Wilbur Thomas, Krause's Welding Foreman says, "The Twinarc not only welds faster, but higher currents make it possible to weld the angles without cleaning off light rust and oil which used to cause some imperfections when a single wire was used."

This application has proved so successful at The Krause Corporation that they are now installing their second Lincolnweld Automatic welder with a Twinarc attachment.

For help with welding procedures, or cost reduction ideas, call your Lincoln welding engineer today.

Wilbur Thomas, Welding Foreman, "Savings justified the purchase of a second machine."

Catalog Available

Complete information on Lincolnweld Automatic Submerged Arc welding equipment and accessories is contained in Bulletin 5200.1. A copy may be obtained by writing, on your letterhead to Lincoln.

THE LINCOLN ELECTRIC COMPANY

Dept. 1755 • Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment

MAY, 1959

Welding Engineer

ESTABLISHED 1916

Fight inflation

DURING THE PAST 18 years, the dollar's value has decreased more than one-half. And many of us have unconsciously contributed to this condition — a condition which has robbed us of purchasing power, reduced our savings, decreased the value of our insurance, and minimized the value of any pensions we may some day receive.

How did we do it? Here's an example:

If the weldor in the shop or the engineer in the office feels it "wise" not to produce as much per day (although receiving more money), he may be making the job last longer — but he is also making it cost more. And eventually, it will cost *you* more.

Another example is the reckless-spending programs followed by our elected Washington officials. Senators and Representatives continue to vote for "government hand-outs" at home and abroad, so now every man, woman and child is saddled with a debt of more than $2,000.

More than likely when you submitted your income tax return, you were not too happy with the "paper-bite" for the past year. We say paper-bite because you didn't pay very much on April 15.

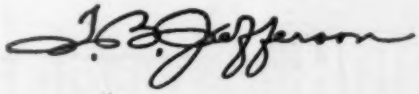
Your employer had been withholding and paying for you. As an average wage earner working 22 days a month, you should analyze your tax statement — *you are working about seven days a month to pay taxes.*

This isn't good, you say? We agree with you.

But it can be corrected: by doing eight hours of work for eight hours pay; and by protesting to Senators and Representatives about high taxes and reckless spending.

Everyone must do this and do it now. Inflated dollars may look big, but they are costing you money, more money than you realize.

Let's stop inflation now — *before it's too late.*



You get VICTOR QUALITY thru-out this package

We've assembled the Super-Range unit for the man who wants a first-class, complete outfit, ready to handle a full range of shop work—welding, cutting, heating, brazing, soldering. Everything needed to go right to work is included.

Every item listed is Victor's standard, top-quality apparatus . . . and you get the complete outfit for only $99.00. Order from your Victor dealer now.

Profitable dealerships open in a few areas; inquire now.

Two Victor single-stage safety regulators,
Model SR 210-970 Acetylene
Model SR 200-967 Oxygen

Victor welding torch Model 100

Victor cutting attachment Model 550-100

Victor welding torch nozzles, Type 13, sizes 0, 2, and 4; (welds to ¼")*

Victor cutting tip, Type 5-101, size 1; (cuts to 1")*

12½ ft. dual welding hose, 3/16" diameter

Spark lighter, goggles, and wrench

*By adding Victor nozzles and tips of larger or smaller capacities to Super-Range unit, you can greatly increase the working range.

VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; high pressure and large volume gas regulators; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines. 54

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J. C. Menzies & Co., wholly owned subsidiary

Welding Engineer salutes

OIL'S FIRST CENTURY -BORN IN FREEDOM WORKING FOR PROGRESS

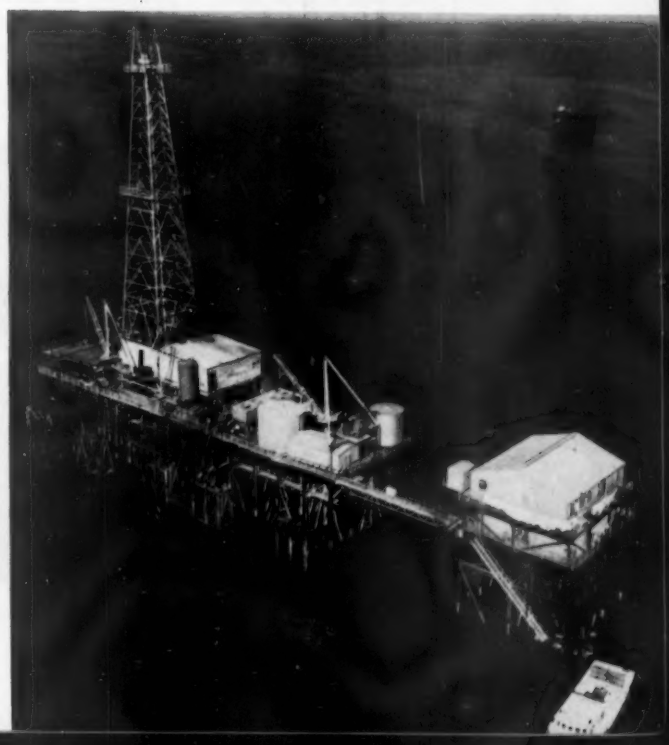
THE DIFFERENCE between 69½ ft and 25,340 ft—that and 100 years of progress separate the wood-housed salt driller of ex-railroad conductor Edwin L. Drake and today's gleaming, steel oil drilling rigs.

(Commemorating this century of oil progress will be the 1959 International Petroleum Exposition to be held at Tulsa, Oklahoma, from May 14 through 23.)

For Drake, a good day's progress into the stubborn Western Pennsylvania rock near Titusville was measured in inches. A far cry from the almost 5-mile-deep shaft biting into the earth at Pecos County, Texas.

Arriving from Stamford, Conn., in the spring of 1858, Drake's job was to increase Seneca Oil Co.'s production through the only known means at the time—skimming it off oil-topped water.

American industry was expanding; the nation was growing. But industrial machinery was running at quarter-speed because of poor lubrication. Tallow and animal fat were being used; petroleum was a possibility, but production was low—and costly.



ONE HUNDRED YEARS . . .

Drake reconstructed the entire production site at Titusville—new channels, troughs, skimmers and skimming methods—with a final result of a meager 10-gallon-per-day output compared to the former four to six gallons per day.

The only solution—get closer to the oil!

Drake ordered his crew to dig straight down — and became the laughing stock of Titusville. When a flow of oil *was* struck, the nearby river water came pouring in, almost drowning his workmen.

Thus was "Drake's Folly" born, but not stifled. The next step—to *drill* for oil like they drill for salt.

His requests for money from Seneca Oil went unanswered. So with a borrowed $500, an old salt driller, a steam engine, hemp rope, a homemade bit and a crude wooden windlass, Drake continued on his own.

Constant flooding led to the final step in development of the basis for modern oil drilling — encasing the drill shaft in steel piping to keep the water out.

On August 27, 1859, drilling stopped at 69½ ft. The next day, "Uncle Billy" Smith, who was in charge of drilling operations, found the pipe filled with the dark-green bubbling liquid. The resulting effect of the news rivaled California's gold rush of 10 years previous.

Thousands rushed to the Pennsylvania oil region; entire towns sprang up overnight in a 50-mile radius. A new age was in the making.

Machines began full-speed production. Railroads criss-crossed the nation. Steamship lines flourished. Within five years, the petroleum industry was a major force in America's daily economic life.

Besides the needs it filled for lighting and manufacturing, oil itself created new industries—industries to meet its own requirements for storage, transportation and pipelines. Refining research opened new avenues for oil as a source for both heating and power.

When electricity outdated oil illumination, petroleum took over as electricity's main power source. When the horseless carriages made their debut and coughed for recognition, oil found another industry for its numerous services.

Today the United States depends on oil for all lubrication, for more than 66% of its energy supply, and for a major portion of its highway surfaces. With only 6% of the world's population, the United States has 40% of the world's total power output.

The oil companies saw the need to combine petroleum with science, and new oil fields were soon opened because of drilling done on a sound geological basis. The companies also pioneered the use of high-tensile steel for pipeline application, and revolutionized oil transportation.

Welding's contributions to this industry have also been important—from the hardfaced drilling bit used to get at the oil, through the welded pipelines used to carry the crude oil, to the refineries where the oil is processed.

Wrought-iron pipes were used at Titusville as early as 1865, utilizing a screw coupling to join the pipelengths. (See the history of pipelines in the following article.) But the introduction of *welded* pipelines provided an entire new industry—as well as a tremendous cost savings for the oil companies.

Service life of the drill bits was increased because of hardfacing; refinery tanks were made leakproof and pressure tight through welding. The oil industry has helped promote welding, and welding in turn has contributed much to the oil industry.

And this emphasis by the oil companies on science is the reason why petroleum by-products make life easier—and richer—in the United States. Harnessing the great supplies of natural gas which were once burned-off has added another resource to the nation's wealth.

Discoveries in petrochemistry alone have added more than 7,500 useful products to our way of life. A list of these products reads like modern America's basic needs: synthetic rubber, plastics, fabrics, solvents, detergents, fertilizers, insecticides, weed killers, medicines, and finally the fuels for rockets and missiles which are propelling us into an even newer industrial age.

By 1967, petroleum consumption is expected to rise by 2 billion barrels a year, and by 1965, the total output of petrochemicals will total 85 billion lb per year.

The end for "Drake's Folly" is nowhere in sight, thanks to science.

NIGHT view of the International Petroleum Exposition, Tulsa.

More than 1,400 exhibits valued at approximately $500 million will be grouped on the 30 acres allotted to the International Petroleum Exposition this year in Tulsa. Attendance is expected to top 30,000—which includes oil men who buy, specify and use the equipment and services on display.

Foreign attendance from more than 50 countries is expected to triple

HIGHLIGHTS 1859-1958

1859—Drilling of first commercial oil well completed at 69½ ft by Edwin L. Drake near Titusville, Pa., on August 27. Oil was found the next day by "Uncle Billy" Smith, in charge of drilling operations.

1860—First West Virginia oil well completed at a depth of 303 ft on Burning Springs Run, Wirt County, May 1. A patent for cracking oil at atmospheric pressure granted to Luther Atwood, May 15.

1861—First full cargo of oil in barrels exported to London from Philadelphia in December. First flowing well drilled by A. B. Funk on the McElhenny farm, Venango County, Pa.

1865—First successful pipeline completed in October in Western Pennsylvania by Samual Van Syckel, using 2-in. wrought-iron pipe from Pithole to Miller farm, less than five miles. Two pumps moved 800 barrels of crude daily. On Jan. 7, first well on Pithole Creek came in with daily production of 250 barrels.

1866—Patent for increasing oil production by exploding torpedoes at well bottoms granted to E. A. Roberts on August 1. First Texas oil well completed on September 12 near Oil Spring.

1870—The "Charles," first vessel fitted for bulk shipment of oil, loaded in New York, May 4. Its 59 iron tanks had a capacity of 794 tons.

1872—Titusville piped for natural gas for domestic purposes. Gas was delivered through 2-in. line from a well five miles northeast.

1879—First long-distance pipeline transported oil from Titusville across the Allegheny Mountains to a railhead at Williamsport, Pa., over 100 miles away.

1892—First commercial oil well in Kansas came in at Neodesha, Nov. 28, from a depth of 832 ft.

1893—Kerosine pumped 252 miles from Pennsylvania oil regions to Wilkes-Barre on June 24; first important movement of refined oil by pipeline.

1895—First seamless pipe produced in U. S.

1897—Oklahoma's first commercial well struck oil at 1,320 ft in Bartlesville.

1898—First Texas refinery stills fired on Christmas Day at Corsicana.

1901—The Lucas gusher, largest well yet discovered, came in at Spindletop, Texas, Jan. 10. On Sept. 21, Louisiana's first oil well came in at Jennings field.

1910—The Lake View gusher near Maricopa in California's Midway field, started flowing at dawn, March 15, and continued for 18 months until Sept. 9, 1911, when it caved in. It produced 9 million barrels.

1913—Patent issued to William M. Burton for the first basic cracking process, Jan. 7. Commercial cracking units under this patent began operating the same month at Whiting, Ind.

1915—Patent for the Dubbs cracking process—distillation under self-generating pressure—was issued on Jan. 15.

1918—First gasoline pipeline in operation Jan. 1; a 40-mile, 3-in. line from Salt Creek to Casper, Wyo.

1922—American Petroleum Institute created a general committee to investigate, develop and approve API standards for manufacture of oil field and refinery equipment on Dec. 21.

1930—Dad Joiner's well came in Oct. 3, opening the great East Texas field. Construction started on the first multi-product, long-distance pipeline on Aug. 9, extending initially from Borger, Texas, to East St. Louis, Ill., then extended to East Chicago, Ind.

1937—First commercial catalytic cracking plant went on steam at Marcus Hook, Pa., April 19 with a capacity of 10,000 barrels daily.

1942—First successful Virginia well in the Rose Hill field came in May 7. Crude oil was turned into the "Big Inch" war emergency pipeline running from Longview, Texas, to Norris City, Ill., Dec. 31. The line was later extended to New York.

1944—"Little Big Inch" pipeline from Beaumont and Houston, Texas, to Linden, N. J., started operating Jan. 26, carrying seven different refined products. Allies invade Normandy on June 26, and "Operation Pluto," a pipeline to fuel the forces, was laid across the English Channel.

1951—U. S. portion of Williamston Basin, largest oil-bearing sedimentary deposit in nation, opened on April 4, with discovery of oil in the Beaver Lodge field, N. D.

1953—First commercial oil found in South Dakota, Nov. 9, in the Custer area. A record for exploratory drilling established—13,313 exploratory wells drilled in one year.

1954—Nevada's first commercial oil well began producing on Feb. 18, 60 miles southwest of Ely. Legislation returning title of offshore lands within their historic boundaries to the several states upheld by the Supreme Court in March.

1956—Producing oil well in Lake Washington field, southern Louisiana brought in on May 5 at 21,465 ft. In the Gulf of Mexico, 22 oil or gas fields found, bringing total to 91.

1957—Largest oil refinery built at one time as a unit officially dedicated in Delaware, May 23. "Mr. Gus II," largest drilling platform yet built, commissioned in Beaumont, Texas, May 31. Completion of first well in Grays Harbor County, Aug. 2, marked Washington's entrance into ranks of oil producing states, bringing the total to 31.

1958—World's largest tanker, chartered by a U. S. oil company, launched at Kuri, Japan, Dec. 6. Vessel has capacity of 1,021,000 barrels. Deepest well in the world reached depth of 25,340 ft in Pecos County, Texas, on Oct. 27.

that of the 1953 show.

One of the major highlights, as in previous shows, will be the Hall of Science where technological and scientific progress of the oil industry since the last show in 1953 will be displayed for layman and oil man.

These scientific exhibits as well as the show exhibits will cover the vast range of equipment used in oil production, exploration, drilling, transportation, refining, and will also include natural gas production and allied fields.

One of the highlights among the show exhibits will be a display of all the newest pipe welding techniques. (A list of welding equipment manufacturers who will maintain displays at the centennial exposition follows this article.)

All exhibits at the show will be operational. Some of the displays include: a full scale turbo-drill, the world's largest truck, sonic pumps, percussion drills and the newest magnetic recording devices for seismic information.

Other exhibits will feature reservoir recovery methods, refinery control by computers, new power supplies, drilling rigs of all sizes and shapes, safety equipment — and all new and improved equipment used in, and allied to, the oil industry.

All told, there will be 150 exploration exhibits, 375 on drilling, 400 on production, 350 for pipeline, 325 on refining and 75 exhibits dealing with petrochemicals.

Among probable Petroleum Exposition exhibitors displaying welding equipment and accessories for oil fields, refineries and pipelines are:

Air Reduction Sales Co.
Ampco Metal, Inc.
M. J. Cross Mfg. Co., Inc.
Crutcher-Rolfs-Cummings, Inc.
Eutectic Welding Alloys Corp.
H & M Pipe Beveling Machine Co.
Harnischfeger Corp.
Haynes Stellite Co.
Hobart Bros. Co.
Kennametal, Inc.
Lincoln Electric Co.
C. A. Mathey Machine Works, Inc.
North American Philips Co., Inc.
Pipe Line Development Co.
Raybestos- Manhattan, Inc.
A. O. Smith Corp.
Smith Welding Equipment Corp.
Tracerlab, Inc.
U. S. Steel Corp.
Victor Equipment Co.

Multi-station welding when fabricating

"THE ORTHOFLOW CATALYTIC CRACKER we're building for American Oil Co. is beginning to look like a Christmas tree, we have so many welding wires draped around it. Couldn't we have just one wire running up the tower to supply all 24 weldors working on the cat cracker?"

This complaint was voiced by our field construction manager several months ago. Upon discussing the problem with my associates, we decided that an effective multi-station welding system eliminating the many wires could be devised.

Under the system being used it was sometimes necessary for a weldor to run a 200-ft line from his welder to his electrode holder. When working on top of a cat cracker—an all-steel vessel vital to modern petroleum refining—a weldor must climb down to his power source to make an arc adjustment. Sometimes crackers are 20 stories high, and such maneuvering is quite time-consuming.

We decided it would be more practical, and time saving, if weldors had convenience outlets near their work and a rheostat or resistor within reach to adjust amperage.

Since multi-station welding was not new to general industry—it being commonly used in shipyards during World War II—our first step in developing a system for refinery jobs was to find a suitable power source.

The Navy had been working with welding manufacturers to perfect a constant-potential source. One machine, a standardized 1,500-amp unit, could provide 2,250 amp for a long enough time to burn one electrode. The same machine, for 15 seconds, was rated at 4,100 amp.

Naval tests of the units were successful, but a weldor had to carry a 50-lb resistor to control the arc. Kellogg used the resistor, but modified it so it is only half that size.

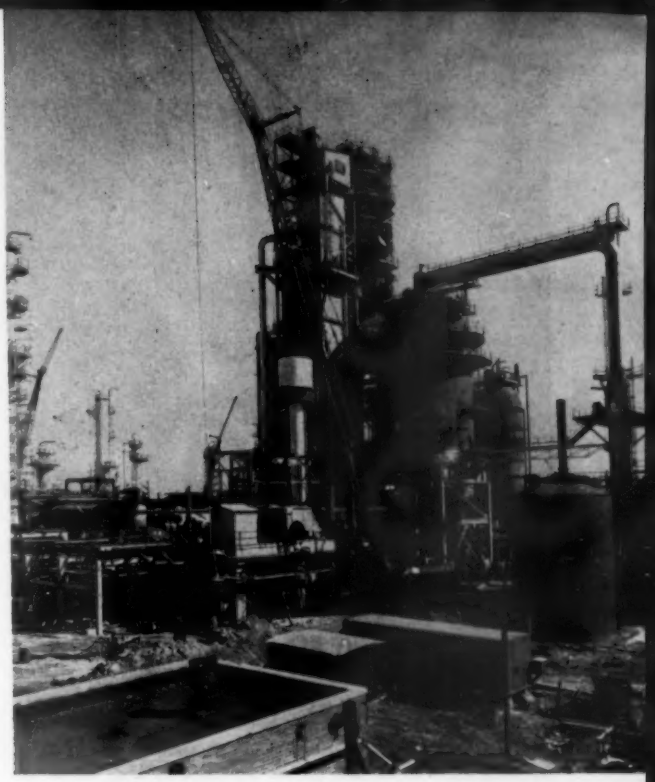
Before using the new unit, Kellogg had developed a wiring system for one cat cracker. The system proved so versatile, a standard set of instructions was adopted, and the system was able to be transported and used again on successive jobs. One job it was adapted to was the $40,000,000 Standard Oil Co. of Ohio oil refinery at Toledo. It aided construction so much, a second system was used along the refinery pipe rack.

The first multi-station units developed by Kellogg were powered by two 1,500-amp machines developed by A. O. Smith Corp., Milwaukee—one a germanium rectifier the other a silicon rectifier.

Ground wires for each unit con-

The past 100 years have seen the progress of the oil industry and the components which helped it grow. Simple units like one at left were once used to refine oil, but now complex structures like one at right are needed. This is Standard Oil Co.'s $40,000,000 Toledo, Ohio, refinery. The multi-station welding system described here was instrumental in erecting this giant.

by C. H. Voelker
Chief Welding Engineer
M. W. Kellogg Co.



money saver
modern refineries

sisted of two pairs of grounds made of three 500 MCM leads brazed to a heavy steel plate. The plate was welded to the vessel being worked on.

Welding lead wires were two 300-ft 500 MCM leads stretching 150 ft in each direction away from the machine. The leads were chosen because they could be more easily manipulated by weldors than heavier wire. Each convenience outlet was connected to the welder by a 20 or 50-ft lead.

A flexible cable consisting of 1,900 strands was chosen so a weldor handling two leads would not have any difficulty inserting them in the junction box. Experience later showed that the flexible cable could be reduced to 10-ft lengths and the stiffer, and less expensive, 500 MCM wire could be used on long runs.

To make the system as flexible as possible, six-way outlets were installed instead of duplex outlets. Two types of plugs were designed. One, D1102, was designed for use at the ends of 500 MCM leads. Thus, when one lead is plugged into the junction box, six weldors can use the outlet.

Field erected pressure vessels are usually fabricated with the axis of the cylindrical sections in a vertical position. In erection, a ring of plates (course) is tacked up. A weld crew works on the vertical seams while a tacking crew starts the next course. This necessitated convenience outlets at two levels, and made it necessary to develop the second type plug.

This distribution block arrangement, D1101, provides two inlets for the dual 500 MCM leads from the rectifier and two outlets to extend dual 500 MCM leads to the next level. Also provided are two outlets for 500 MCM leads which can run to the two terminal outlets of the D1102 type plug. This system accommodates six weldors, too.

These two types of boxes are very versatile. Two D1102's and one D-1101 can come off one D1101. This becomes a quick line connector for extending leads. The arrangement can be expanded step by step as the job progresses.

If activity develops along either or both sides of the main line, such as during preassembly, the D1101 permits the placement of one or two 500 MCM lateral lines to establish two local areas for six weldors each.

The most important advantage of the new system is the availability of a convenience outlet at any level where a weldor must work. The leads can be run inside structural steel lines or integrated with scaffolding. This means, with two main lines running in either direction from the rectifier, one can be used outside the vessel, the other inside.

In pipe racks, where pipe runs in bays along the equipment, a 300-ft lead is used—a 150-ft extension running to and from the rectifier. Pipe-runs from the rack to the vessels can be handled by installing D1102 outlets.

The new system allows Kellogg to save time, money and space when working on a refinery job.

Time is saved because weldors have plugs within easy reach at all times. This eliminates many steps and allows perfect arc adjustment within seconds rather than minutes.

The wiring system connected to a 1,500-amp source, supplies energy for 30 weldors. Before, contractors had to use thirty 300-amp generators, or 400-amp individual rectifier welding machines to supply 30 weldors. Total capacity of the machinery was 9,000 to 12,000 amp instead of 1,500.

Also, larger numbers of weldors can be supplied by paralleling. If 120 weldors are needed in an area they can be supplied with power from a bank of four 1,500-amp machines.

Money and space are conserved because the one machine needed to power the entire multi-station system takes the place of many machines.

MAIN pipeline from McAllen, Texas, to Miami crosses one of a dozen rivers. Most of the pipe used on the 1,472-mile main line is 24-in. diameter.

More than 2,596 miles . . .

Pipeline brings first natural gas to Florida

TO BRING NATURAL GAS to Florida, a $164 million, 2,596-mile pipeline system is being built between McAllen, Texas and Miami.

When the line is completed and opened for service early this June, it will carry 282 billion cu ft of gas per day. With the aid of additional pumping facilities, and some parallel lines, gas flow in 1960 is expected to reach 418 billion cu ft daily.

Most of the 1,472 miles of main line is 24-in. in diameter, with other sizes ranging down to 12 in. The 1,124 miles of lateral distribution lines have pipe ranging from 2½ to 18 in. in diameter.

(The Houston Texas Corp. is taking over the gas distribution facilities by absorbing present gas-dealing setups in numerous Florida cities. The company is a parent firm of Coastal Transmission Corp. and the Houston Gas and Oil Corp. Coastal built the line from McAllen to Baton Rouge, La., while the remainder of the line into Florida was constructed by the other transmission subsidiary.)

The 124,000 tons of pipe used on this job constituted the largest order ever delivered from Republic Steel Co. mills at Gadsden, Ala. The 24-in.-diameter, 0.312-in.-wall pipe, produced in 30-ft lengths, was double-jointed at the mill, using automatic submerged-arc for the required 60-ft lengths.

The double-jointing technique, developed by Mid West Welding Co., Ltd., involved two outside passes and an inside (root) pass.

All double-jointing was done with a 3/32-in.-diameter No. 36 wire, 46 ipm, using a constant potential power source. Welds were made while rotating the pipe.

The first outside pass, a filler bead, was made with the electrode set 1⅞ in. ahead of center, using d-c straight polarity at 650 amp, 26 volts. The second pass, also outside, was a cap bead. The electrode was set 2¼ in. forward of center, and again, d-c straight polarity was used with 650 amp, 38 volts.

The third and final bead of the double-jointing was on the inside, this time using d-c reverse polarity with the welder set to deliver 500 amp at 31 volts.

This double-jointing was done during two 8-hour shifts per day, with a schedule set up for 155 joints per shift. Production records show 300 to 355 welds were made daily during the two shifts.

Mill production of 18,000 to 20,000 ft of pipe per day was not too fast for the pipeline crews who were laying from 12,000 to 18,000 ft per day. Crews consisted of three stringer-bead, four hot-pass and nine firing line weldors.

This high-speed footage could be partly attributed to use of 60-ft joints

PIPE for the main line was double-jointed at the mill using automatic submerged-arc with a 3/32-in. No. 36 wire.

A welding and pipelining history

PIPELINING IS BIG BUSINESS—the underground network for transporting natural gas, crude oil and refined petroleum products extends to all sections of our country.

Just how big a business is it? Well, at the beginning of this year there were over 770,000 miles of pipeline worming a pattern across the country—80% of which is welded. It is estimated that during 1959 another 16,650 miles will be added. All these lines will be welded, a job that will involve over 2,170,000 joints.

Pipelines were used to transport natural gas long before Edwin Drake drilled his first oil well. Hollow logs were used for this purpose in Fredonia, N. Y., in 1821. By 1862, cast iron pipe was used on a 4-mile, 2-in. line at Titusville, Pa. Soon after, wrought iron pipe came into the picture, with its various lengths joined by screw-couplings.

A search followed to find a way to make a tighter and stronger joint than the screw-type coupling provided. Attempts were made to oxyacetylene weld lines, the first of these being an 11-mile line laid in 1911 near Philadelphia. In 1914, a 34-mile gas line was constructed near Enid, Okla., followed by another, longer, line in the San Francisco Bay vicinity, which supplied gas for the 1915 Pan American Exposition.

However, the real breakthrough in welding came in 1922 when Prairie Pipeline Co. oxyactylene welded an 8-in., 140-mile crude oil line from Mexica to Jacksboro, Tex. Here, the advantages of welding over screwed couplings was clearly demonstrated.

The final cost of the project was 35% less than it would have been if conventional couplings were used. The cost of weld, labor and material was only $2 a joint.

It was on this job that the idea of roll welding was conceived. Five 40-ft lengths of mill beveled pipe were butted on skids to form a 200 ft section. Four weldors, working simultaneously, tack welded the pipe in two places and then welded it with a single bead.

After half the weld had been made, the pipe was revolved so the other half could be joined. When the 140-mile line was completed, testing to 800 psi revealed only four defective welds.

In the same year, 1922, the first attempt was made to arc weld a pipeline. The job involved 150 joints on a 12-in. line for the Empire Gas & Fuel Co. of Caney, Kan. The contractor was Harold C. Price, then a struggling pioneer.

The job report read, "We welded 12 joints and tested them under 300 lb of cold water. Pinholes in the joints caused leaks making it look like a sprinkling system, but none of the joints broke."

The Mexica job proved that welding was practical and the 1922-23 season saw the last of the long lines built with screw couplings. Oxyacetylene welding seemed to leave little room for improvement, so pipeliners tried to improve pipe.

The first advancement came in 1926 when large diameter, seamless steel pipe was made available. The following year, electric welded pipe came out in large diameters and thin walls.

Competition in joining methods appeared again in 1928 when a 169-mile, 8-in. line from San Augustine to Corsicana, Tex., was arc welded for the Texas Pipeline Co. Eighteen welders mounted on horsedrawn wagons were used on the bare wire job.

Firing line weldors were guaranteed $1 an hour, for 10 hours, plus 40¢ for each weld over 20. Bell hole weldors received $1.10, plus 60¢ for each weld over 12. During four months, 20,881 welds were made.

Arc welding got a real test in 1929 when it was used to join bell and spigot joints on a 12-in. line from Oklahoma to Chicago. However, the results were not wholly satisfactory, with 45 breaks occurring in the welds during the first year.

The coated electrode was introduced to pipeline welding in 1930 when it was used, and quite satisfactorily, on a 32-mile, 20-in. line in Kansas.

Now that weld and pipe quality had been improved, attempts were made to improve the type of joints. Several changes from the bell and spigot resulted.

First, a double bell with a back-up ring system was used, then plain ends with a back-up ring and, in 1933, a plain end without a ring. The same year, the stove-pipe method of construction was employed on a line near Turnertown, Tex. The method is still being used.

By 1934, arc welding was serious competition for gas welding. In an attempt to speed-up oxyacetylene welding, a three-flame tip was introduced. It helped a little, but not enough. Four and six-flame tips followed, but these innovations failed to stop arc welding from taking over first place, where it has remained ever since.

While arc welding has taken over as a means of joining pipe, the oxygen flame still plays an important part when it comes to cutting pieces and truing pipe ends.

Pipeline welding is now a highly developed operation which requires careful selection of workmen and materials. Prior to any pipe job, weldors must pass rigid qualifying tests to be sure the men can do the job. Type and size of electrodes and wires must also be carefully selected if the materials are to do their job.

The welding operation usually starts with a "stringer" bead, the first one around the joint. This is followed by a "hot pass" which deposits little metal, but which has an annealing effect retarding cooling of the stringer bead, and which, also fills the pinholes. Then the filler is added and the cap bead laid.

During work, the welds themselves are closely inspected. Visual examination, internal and external X-ray and internal gamma ray methods are used to see that top quality welds are made. Welding coupons are cut and tested for tensile strength, soundness and ductility.

Welding has proved itself as a pipeline joining method in less than half-a-century. Today it is being used on lines of 2 to 60-in. diameters. One simple fact says as much for the effectiveness of the method as anything else—pull tests show that properly welded joints are stronger than adjacent pipe walls.

THE 8-in. spur crossing Florida's west coast at Oneco heads southeast for a tie-in with the main line.

instead of the conventional 40-ft lengths. Line-up crews claimed the 60-ft joints were as easy to handle as 30-ft lengths.

Although these longer lengths supposedly increased field operation costs by one-third, there was an overall net savings of 16% because the number of weld joints were reduced one-half. A field weld on a 24-in. joint cost $27.50 compared to $13.50 for double-jointing a mill weld.

All double-jointing at the mill was X-ray inspected; however, only about one-third of the main line joints were X-rayed. Welds connecting into lateral distribution systems received full X-ray inspection.

Pipeline laying for these lateral systems is handled by eight different contractors. One, Harbert Construction Co. of Birmingham, Ala., reports the 8-in. spur now crossing Florida's west coast at Oneco is being ditched in at a rate of 3 miles per day on its way to tie-in with the 20-in main line at Miami.

Jim Fraley, head of the Oneco spread, considers the 3-mile-a-day rate good because much of the muddy terrain would not hold any amount of weight. Production has also been slowed by right-of-way disputes.

Aside from the swampy terrain and the right-of-way problems, rip-rapping must be used constantly to cut a pathway through brush, trees and undergrowth so long flatbed trucks can be winched across.

Where rip-rap cannot be employed economically, the diesel-tractored sidebooms are brought up to lug the pipe sections to the job site.

The soon-available natural gas will supplant propane gas now used in numerous communities. The line, scheduled to span bayous, hundreds of miles of swampland, and cross under the Braden and Manatee riverbeds, will serve close to 400,000 consumers at an estimated saving of 15% in cooking and heating bills.

In anticipation of the unlimited and lower-cost fuel, electrical generating plants in Miami, Daytona Beach, Jacksonville, Orlando and other areas, will use gas in their operation. Florida Power and Light Co. alone is expected to account for millions of cubic feet of gas for this use.

According to Richard Carr, general manager of Southern Gas and Electric Corp., target date for metering natural gas into Florida's Sarasota section is June 1.

Welds on the pipeline in this spread are made with 1/8, 5/32 and 3/16 in. electrodes. An E6010 with a 5/32-in. diameter is used on the stringer bead. For the hot pass and filler, E7010 is used, 5/32-in. diameter for the former and 3/16 in. for the latter.

Cap welds are made with either E6010 or E7010 in the 3/16-in. size. Using 40-ft-long pipe, approximately 17,000 ft per day are laid, with two bead bands, two hot pass bands and four backend weldors. About 200 lb of the three electrode sizes are used daily for each 40-ft section.

One recurring problem is a result of the short 30-deg bevels on the pipe instead of the standard 37.5-deg bevel. Slag must be cleaned out continuously, since it is difficult to get out on the hot pass. A wide space must be held for the stringer bead in order to place the hot pass down.

Another problem is buoyancy. The 20-in. pipe is welded so that each joint weighs 14,000 lb. When buried, it remains in the ground—but when gas goes through, miles of pipeline begin rising to the surface because of the added buoyancy.

As a result, a negative buoyancy is being provided by engineers. Giant concrete weights will encase the pipe along its length, fitting its circumference in two cast-halves.

In areas so watery with muck as to provide little or no footing for tractors, three of the big machines make a combined lift of 35 tons of pipe. The three welded sections are then pushed through the muck.

Florida is the last major population area in the nation without natural gas service. To a state with an economy hinging on citrus and tourists — both dealt a heavy blow last year by cold spells—the pipeline promises a much-needed industrial shot-in-the-arm.

Numerous industries have avoided the state in the past because of this lack of natural fuel. But thoughtful speculation by industry seeking southern locations has already resulted in about $39 million in new plants either in construction or on the drawing boards—all because of Florida's first natural gas pipeline.

WELDORS used three different sized electrodes for all applications on the lateral distribution line on the Sarasota spread. Pipe's 30-deg bevel gave considerable slag trouble.

FISH-tail bits of the early 20's had small pieces of tungsten carbide set with oxyacetylene torch on wing edges and cutting faces, followed by a weld overlay. At right, a partially completed modern-designed bit shows use of square-corner cobalt-borium inserts (on left).

Hardfacing drill bits— another contribution to the oil industry

UNTIL AUGUST 27, 1859, the only source of "rock oil" anywhere in the world was from seepage, that is, from those places where oil oozed from the ground.

The area near Titusville, Pa., was such a place. However, seepage was slow—and the demand for oil was high. Because of this high demand, Edwin Drake's job was to increase oil production.

The result: drilling for oil as you might drill for water or salt.

That someone had not attempted drilling before "Colonel" Drake is amazing—and equally amazing is how close he came to failure.

Using a churn drill, operations went smoothly enough for the first 39 ft through relatively soft mud and shale. When drilling hit sandstone, however, progress was slowed and breakdowns were frequent because of the rougher drilling conditions.

Costs were running higher than anticipated; Drake's local backers became tired of "throwing money in a hole in the ground." He had drilled through 30 ft of the tough sandstone, to a depth of 69 ft, when the drill bit broke again.

Seneca Oil Co., whom Drake represented and who had ignored his requests for money, finally wrote, telling Drake to stop all operations. In the face of all these reversals, Drake was ready to comply, when the well filled with oil—oil at 69½ ft near Titusville, Pa.

There is a great contrast between Edwin Drake's well and the Phillips Petroleum Co.'s 1-EE University well in Pecos county, Texas. The 1-EE has been drilled to a depth of 25,340 ft.

Today's knowledge of welding and metallurgy would have simplified greatly Drake's well-drilling problems. This technology has made possible extensive oil drilling, which last year involved the sinking of approximately 49,111 wells.

Hardfacing made its debut in oil drilling operations in the early 1920's. Two weldors in a West Coast oil field were experimenting with the use of welded overlays to prolong the service life of drilling bits.

The Stoody brothers operated a job shop in Whittier, Calif., only two or three miles from the Santa Fe Springs oil fields, from where much of their job shop work was coming. They found the jobs generally involved drawing out and rebuilding with high carbon, the drag bits, swing bits and discs commonly used in drilling operations in those days.

Both the customer and the Stoody's felt that the rebuilding jobs they were handling should last longer than they

were. So, unknown to the customer, the brothers began an intense series of experiments.

Among the first deposits used was a fabricated mild-steel tubular-rod which had been filled with granular chrome-alloying elements. In a comparatively short time after applying this experimental deposit, the bit service life was increased ten or more times. Thus hardfacing was born.

Further experiments led to development of cast rod, which was notably superior to the original hardfacing material. But by this time the oil drillers were asking for even harder materials that would wear longer.

Rotary drilling had recently come into use, and every time a bit wore out, it was necessary to pull up a long string of drill rods to replace it—a costly and time-consuming process. However, this led to the introduction of tungsten carbide particles, which could be applied with a steel matrix.

The pea-size particles were first set in the wearing faces to take the major abrasive action of drilling. Later, much finer particles were produced, and encased in a fabricated tube. Using an oxyacetylene torch, a heterogeneous deposit could then be made.

Advances in the use of hardfacing in various forms continued, and as a result these materials were used in all phases of oil field production. All types of bits, drill collars, tool joints, fishing tools and countless other pieces of equipment receiving severe abrasive wear had their service lives increased.

The use of rotary drilling has grown to a point where last year, of the more than 49,000 wells drilled, 40,500 used rotary bits. These bits, fitted with multi-toothed angular cutters and side rolls, are ensured of long service because of the tungsten carbide particles.

Although oxyacetylene welding still retains an important role in hardfacing, arc and Tig welding are finding increased applications. And on drill collars, tool joints and other pieces of equipment, automatic welding is coming into play. An example of one application in this area is in hardfacing tool joints.

In the Toledo, Ohio, plant of The National Supply Co., Pittsburgh, hardfacing with tungsten carbide particles has become a production-line process because of the high rate of wear on drill-pipe couplings during drilling of deep oil wells.

A rotating drill string can penetrate thousands of feet into sand and rock, and the couplings, or tool joints, receive the major portion of abrasive wear because of larger diameters.

National Supply solved its hardfacing production problems with an automatic, gas-shielded, surface-melting arc, and a metered flow of tungsten carbide particles into the molten pool behind the arc on the rotating tool joint. A non-consumable electrode melts the surface of the tool joint to a depth of ⅛ in.

This automatic process now being

TOOL joints can now be hardfaced using automatic Tig welding. Tungsten carbide particles are metered into pool behind arc melting the surface of the rotating joint.

used has three major advantages over the original, which was an open arc operation using coiled-tubular rod containing the carbide particles.

(*1*) Overlay carbide is now uniformly distributed for most effective wear resistance, and spalling and cracking have been practically eliminated. This is a result of keeping carbide particles out of the arc, and thus minimizing dilution with the tool joint's parent metal.

(In the original hardfacing process, when carbide particles passed through the open arc, some melted and others sank to the bottom of the deposit. The melted particles alloyed with the steel, producing a hard matrix, which was susceptible to cracking and spalling. Those particles which sank were of little use until the surface was worn down.)

(*2*) Only tungsten carbide is deposited when using the Tig process since there is no steel rod to melt into the surface of the AISI 4142 alloy steel tool joints. The deposit is 100% tungsten carbide instead of 60%, as was common in the former open arc method.

(*3*) Finally, Tig welding eliminates a complex grooving operation which was necessary in preparing for the open arc welding process.

When Tig welding at National Supply, the tool joints move on a conveyor through an induction heater which raises the temperature to 750-800 F. This maintains the original physical properties of the steel through the entire welding operation.

One of the operators on the two automatic Tig welding machines first clamps the preheated tool joint in a three-jaw lathe chuck. He then aligns the ⅛-in. non-consumable thoriated tungsten electrode and closes the electrical circuit to strike an arc. The helium shielding gas begins flowing at 40 cfh.

As soon as the surface metal melts, the operator begins rotating the tool joint and regulates the flow of tungsten carbide particles. The 20/30 mesh particles work down through a tube behind the arc from overhead vibrators.

After a single revolution of slightly more than 360 deg, the welding head indexes lengthwise two-thirds of a bead width to make another pass. This slight overlap gives an interlocking effect which eliminates washout between the beads.

Welding and indexing continues automatically until the deposit has the required width—in this case about 3 in. on a typical 5¾-in. OD tool joint.

Stress relief is a two-step process starting in an induction furnace, into which the tool joints move on a conveyor for a 3½ minute postheat to ensure a stress relief temperature of 1,000 F. The tool joints are then passed into a vertical gas furnace where they are held at 1,000 F for 90 minutes. Cooling takes place in still air on racks.

With this type of knowledge and technology, Drake's first drilling operations would have been considerably easier, less costly and faster.

WELDOR joins mounting brackets to outside core pieces, while pieces are held in flat position. Note compactness of station. Coil of steel (not in picture) is fed into machine at right which presses laminations and delivers them to weldor's side, as shown. Angle iron frame over welder supports wire feed unit and reactor.

by **Paul J. Hufford**
Hobart Bros. Co.

This manufacturer practices what it preaches

Welding time slashed by firm through use of its own products

WELDING TIME of transformer core pieces has been slashed 62% by Hobart Bros. Co. since it developed an automatic station composed of company-made products.

Previously, laminations of 26 gage electrical steel were blanked in the press department and transferred to the core department. Here, 420 laminations were placed in a jig, manually welded with three 7-in. seams and attached to mounting brackets.

The pieces were then placed back-to-back in another jig and welded to form inner core pieces for transformer windings.

Now, during the new speedy operation, a 2,240-lb-coil of steel is placed on an auto-centering reel and automatically fed through a continuous straightening machine and to an automatic blanking press.

The press produces L-shaped laminations and forces them onto a conveyor which takes them to a pneumatic fixture with duplicate sides.

Next, the laminations are semiautomatically Mig (metal inert gas) welded. A 500-amp constant voltage welder powers an atmospheric air-cooled CO_2 gun, which enables the operator to weld 14 ipm. The carbon-dioxide shield is fed at a rate of 35 cfh. Current is 120 amp, 22 volts. A reactor is used in the welding current to minimize spatter and conserve wire.

The 500-amp welder also powers an automatic unit that feeds 0.045-in. manganese steel wire at 177 ipm.

Conversion to semiautomatic and automatic operations reduced material costs and eliminated cleaning operations, labor and handling of laminations.

PNEUMATIC fixture locks 420 laminations, which makes a 7-in. thickness, together for welding. Operator has just completed welds for outside core piece. Arc welding gun shown is cooled with ambient air, eliminating water hoses and leaks.

The trucking of completed core pieces to subsequent departments was also eliminated since the automated center adjoins the winding department.

Other important advantages of the new operation—45 complete assemblies a day as compared to 25 a day when manual welding was used, and a 45% cut in overall production time.

Water—our most abundant resource. A blessing for crops, lawns and thirsty workers. A curse, sometimes, for housewives, photoengravers and those who own a water softener like the one at the right. What can be done to halt the ravages of hard water . . . ?

Enter: welding

Exit: hard water

EVER LOOK inside Aunt Hattie's teakettle? That crust is the result of hard water action.

Ever rinse after a bath and still feel soap-slimy? That's because of hard water.

After your bath, did you have to scrub away a ring? That ring was there because of hard water.

Hard water . . . the nemesis of housewives and industrialists . . . it complicates their lives and injures their tools. Some sections of the country suffer more from it than others; all are exposed to it.

The harmful elements lurking in the water are calcium, magnesium, and iron. When they react with metal or with soap, the damage they can do is tremendous.

Welding and Water

Fortunately, engineers have learned to fight these elements—by using water-softening machines that owe much of their efficiency to welding.

These machines force the offending water through an ion-exchange mineral bed where the calcium and magnesium are neutralized, washed down the drain. Filtered, soft water is then ready to flow.

But iron is not affected. This iron —and water borne silt—is trapped in the mineral bed. As time goes by, the material builds up in the mineral bed until softening action is brought to a halt.

To remove the waste, water is forced *upward* through the mineral bed, the packed material is loosened, and carried off through the drain.

Brine now filters down through the mineral bed to replace its elements, which were lost during the softening action. The brine salt itself is removed by a rinse of fresh water, and the softener is ready for another cycle.

But this regeneration process is often slow and cumbersome because many water softening systems operate only manually or semiautomatically. Another drawback of these systems is that they use two tanks, one to hold the water and the other to hold brine; thus causing them to hog more space than necessary.

Tank-Within-Tank

Now, however, thanks to welding, a tank—or rather, a tank-within-a-tank—has been introduced which will do the job automatically with no downtime and without bulk.

The manufacturer, Electronic Water Purifier Co., of Chicago and Franklin Park, Ill., utilizes the unique joining capabilities of welding to fasten the mineral-bed tank *within* the brine tank.

Linked to a four-position valve and an electric timer, this unit makes the entire softening process automatic and yet needs little space nor requires constant attention.

Fabricating the softener is Tanks, Inc., of Franklin Park. For the job, the firm uses hot-rolled, copper-bearing steel. Side sheets are formed from 10-gage material; heads (tops) and skirts (bottoms) are made of 9-gage stock.

All welding—with the exception of manual metal-arc tack welds—is submerged arc.

Seam Welding

Initial welds are those along the side sheets' longitudinal seams. Once these parts have been joined, the outer heads are tacked on. Design calls for openings in the heads to permit insertion of the inner tank.

With the inner tank in place, the unit is shunted to a submerged-arc station. Here, heads are finish welded and the inner tank joined to the outer.

The tanks are placed on a variable-speed positioner for the work. Obviously, head welds on the outer tank present little difficulty because they can be made in downhand position. So they are quickly welded with the submerged-arc unit, using a motor-generator power source and a current of approximately 400 amp. The 3/16-in welding wire feeds at 60 to 70 ipm.

Welding the inner tank to the outer demands more skill from the weldor because welds must be made at approximately 45 deg. Yet they are done with the same wire and wire-feed speed.

The tank is then taken off the positioner and spuds are attached with fillet welds, this time on a revolving table.

Skirt Welds

At this point, skirts are tack welded to hold them in place until completion of the submerged-arc work. At this final stage, 23 separate welding operations have taken place.

A protective zinc coating is given to the tanks to resist corrosion. This is done by dipping them in a zinc solution for galvanization. Now all tanks are tested by forcing a mixture of air and soap into them under 300 psi pressure; working pressures will be 125 psi.

As further defense against the attack of hard-water minerals, workers line the tanks with plastic. A polishing operation follows to prepare the metal for an enameling job. Finished weight: 160 lb.

With this unit, says Electronic president, Bernard Lewis, the owner need only start the machine for its cycle to take place. After long periods of time, salt must be added, but normally, no other attention is needed.

From satellites to softeners . . . an easy jump for welding.

". . . skirts are tack welded to hold them in place until completion of submerged-arc work." Tanks in background are ready for next step.

". . . all tanks are tested." After testing, weldor rewelds any leaks. Testing soap is still visible.

". . . they are quickly welded with submerged-arc unit." Here a weldor carefully examines outer head welds, pushing aside excess flux.

". . . polishing operation follows to prepare metal for an enameling job." After welds are ground, tanks will go on to a belt grinder for finishing.

From laboratory to sales room . . . in several months

Long strides in a commercial direction have been taken by electron-beam welding since the first paper on this process was presented little more than a year ago.

If you are looking for the answers to many problems that arise in welding the highly reactive metals now coming into greater usage, you should investigate this newcomer's possibilities.

On these pages, WE reports another entry in the field—High Vacuum Equipment Corp. Only last October, WELDING ENGINEER's *WeldWorld page reported that electron-beam welding was about to leave the laboratory stage—WE didn't suspect how rapidly.*

WE chronicled the news last month that Air Reduction Sales Co. has invaded the field with custom equipment designed for this modified X-ray process. WE also published an article by two General Electric men which comprehensively described the method's theory and operation.

The parade goes on.

Other firms involved in electron-beam development include Westinghouse Electric Corp., NRC Equipment Corp., and Stauffel-Temescal Corp. Overseas, Carl Zeiss of West Germany is another; its U. S. outlet is Electrona, Inc., of New York City.

Of the aforementioned companies, only G-E and Westinghouse have not offered equipment commercially. But considering the work each has done, it would be surprising if they did not enter the field.

Still other groups now engaged in development are Sylvania, Bell Telephone, National Aeronautics and Space Administration, Battelle Memorial Institute, MIT, Alloyd Research Corp., Mallory-Sharon Corp. and American Vacuum Society.

ELECTRON-beam welder from High Vacuum Equipment Corp. is called Beamatron. Unit shown (inset) can weld tubing or parts up to 3⅛-in.-diameter in lengths up to 10 ft.

Another firm offers electron-beam welder to industry

ANOTHER COMPANY, High Vacuum Equipment Corp., Hingham, Mass., has joined the ranks of manufacturers producing electron-beam welding units with the introduction of its "Beamatron" recently.

This unit can weld metals ranging from aluminum to zirconium, as well as tungsten, tantalum or molybdenum to each other or to other metals, with previously unobtainable results, according to the company.

Because most impurities trapped in metal become volatile in the high-operating vacuum of this process, the entire weld zone, not just the surface, is purified. Net result: a weld with physical properties and life expectancies not obtained by other means of welding.

At the same time, the cost of items such as nuclear fuel jackets and electronic parts is reduced by elimination of shielding gases and by a decrease in rejects.

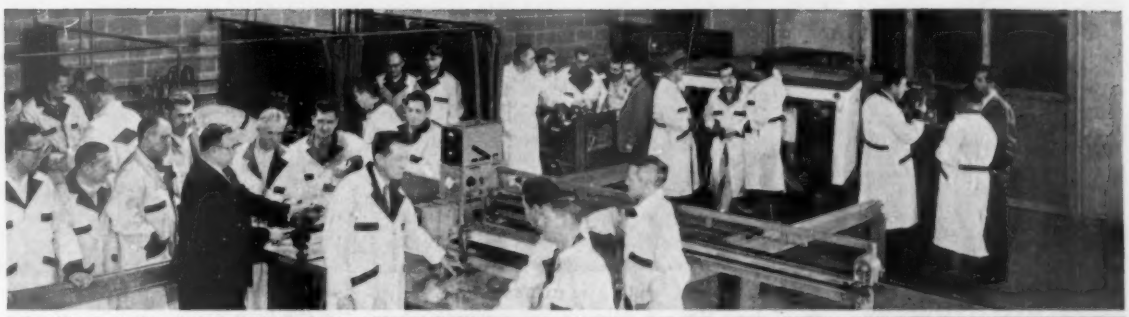
High Vacuum's unit has been designed to weld tubing or parts up to 3⅛ in. in diameter, and in lengths up to 10 ft. A turntable can be installed for spot welding quantities of small parts.

The high-voltage power supply is rated at 15,000 volts at 200 mili-amp —only 3,000 watts. Control circuits are adjusted through variable transformers.

The electron-beam welder is similar to an X-ray tube insofar as a cathode current souree of high velocity electrons is used to bombard the work to be welded, which is connected as the anode. (In electron-beam welding it is possible to obtain sufficient heating from the impact of a stream of electrons—but only if in a vacuum.)

In conventional welders a heating effect adequate to weld metal is obtained with currents of 20-500 amp. In electron-beam welding, an equivalent heating effect is obtained

What new ways can you save with industrial gases ?



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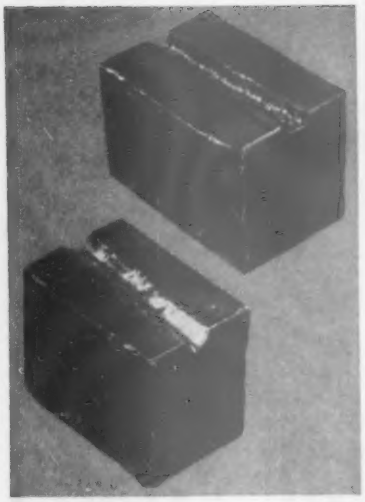

Which stainless steel block was grooved in 12 seconds?

It took 10 minutes to chip a ¼" deep, ⅜" wide groove in this 3¼" long stainless steel block on the left. Arcair did a better job in just 12 seconds . . . or 1/50th of the time. (See block at right.) Groove is 5/16" deep; 7/16" wide. Both blocks were cut from the same stainless.

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with less than 0.2 amp.

A suitable emitter, such as tungsten, is used in a vacuum chamber to produce a cloud of electrons. This emitter, or filament, is housed in an electron gun structure, serving as a control grid.

A small sharp-edged hole is provided on the gun's side nearest the work. As electrons leave the gun through this hole, a high negative potential on the grid causes the electrons to be confined into a small diameter beam, following the rule that like charges repel each other.

High voltage is impressed across the gap between gun and work. For safety, the work is at ground potential, while the gun is at approximately 15,000 volts negative. Electrons are attracted to the positive-appearing work piece. Therefore, a small electric current is flowing to the work.

Current alone, however, is not enough to weld metal, but with 15,000 volts potential, electrons can be accelerated to hit the work at velocities up to 20% of the speed of light.

The individual electron, having a mass of 9.1×10^{-28} grams, strikes the work and gives up its kinetic energy as heat. The amount of this impact heating is expressed as:

Heat in calories per minute = 1.4×10^{-2} EI, where E = accelerating voltage in volts and I = beam current.

When the electron-beam is sharply focused to provide a high electron density, heat-input rate is sufficient to quickly heat the work zone to a molten state. The small heated zone, combined with the high heating rate, minimizes losses by conduction. Silver and copper, for example, can be easily welded.

The system's purity is the key to the numerous advantages of electron-beam welding. High Vacuum Corp.'s experience has shown that satisfactory operation from a purely electronic viewpoint is possible only below 2×10^{-4} mm of mercury pressure. This means the level of atmospheric impurities is less than one part per million.

The best commercially available inert gases are pure only to a level of 15 to 20 parts per million. To the metallurgist and the welding engineer, this means electron-beam welding is always done in an atmosphere better than the best industrial protective atmosphere.

Another bonus from this welding process is removal of non-metallic inclusions from the fusion zone.

Oxides, nitrides and carbides not destroyed by heating in vacuum are ionized to positive ions by electron bombardment. As positive ions, they are lifted out of the melt and attracted to the grid of the electron gun. Most of these particles fall off when the gun is turned off, or they can be brushed off from time to time by the operator.

These two effects, prevention of oxide formations, and removal of inclusions, combine to yield remarkably clean welds. With reactive metals (titanium, zirconium, vanadium) this cleanliness results in higher-than-normal corrosion resistance and a drastic lowering of brittleness and notch sensitivity in the weld and heat-affected zone.

With refractory metals (tungsten, tantalum, molybdenum, colombium, rhenium) welding is possible as a fabrication technique. The increase in hardness usually associated with welding these metals, is lessened to a point where the weld is softer than the parent metal.

Here are some advances in previously difficult to weld materials cited by the firm.

Complex fuel assemblies for nuclear reactors can now be welded and evacuated in a single step with highly corrosion-resistant welds.

Titanium-stabilized super-alloys can be welded without change in titanium content in the weld. In conventional welding practices, this change often results in a lowering of creep strength at the joint.

Beryllium assemblies can be welded instead of using organic bonding materials or complex fasteners. And because of the improved cleanliness, copper and copper alloy assemblies for electron tube parts can be welded without a post weld chemical cleaning process.

These are just some of the headaches of designers and production men which will be eliminated with electron-beam welding. Many metals now difficult or impossible to weld, can be joined on a production basis. And greater impetus will be given to further development of products fabricated of reactive and refractory metals.

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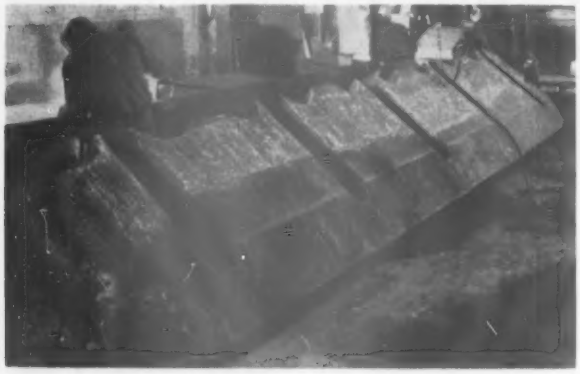
A photographic report on manual hardfacing, prepared with the cooperation of Lincoln Electric Co.

A tale of five parts

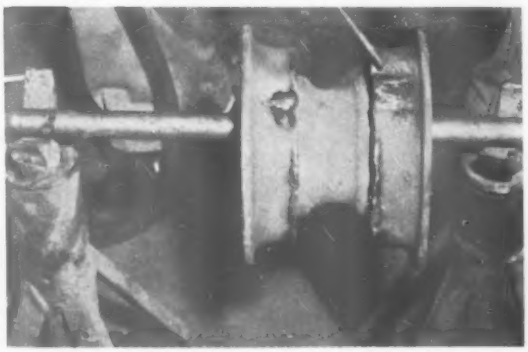
1—Ribbons of hardfacing metal protect all wearing surfaces on this dragline bucket. Working in a steel slag dump, the bucket needs all possible protection, because slag is *ten* times more abrasive than ordinary earth. Most severe wear is absorbed by plates welded to inner and outer bucket surfaces. By using a semi-austenitic electrode type, manually applied in the field, weldors were able to shield it against abrasion and impact loads. On the heel plate, a chrome-carbide electrode was applied since impact is light at this point but abrasion severe.

2—Used in the same slag heap as the bucket, this bulldozer blade is heavily reinforced and has a bolted, manganese-plate cutting edge. Thick beads of semi-austenitic hardfacing material give even more protection because they will not chip under impact loads and will offer tremendous resistance to the abrasive slag. Weldors use 3/16-in. and 1/4-in. electrodes to apply the hardfacing pattern, which was developed after considerable experimentation and proved ideal for this particular job.

3—Chewing steel slag all day, buckets soon need new teeth. Two sets are used: one is on the bucket while the other is in the shop being hardfaced. After having joined a manganese tip to the tooth with stainless steel electrodes, the weldor used manganese electrodes for his remaining passes. Completing the joint, he hardfaces here with semi-austenitic electrodes. The whole job is done once a month.



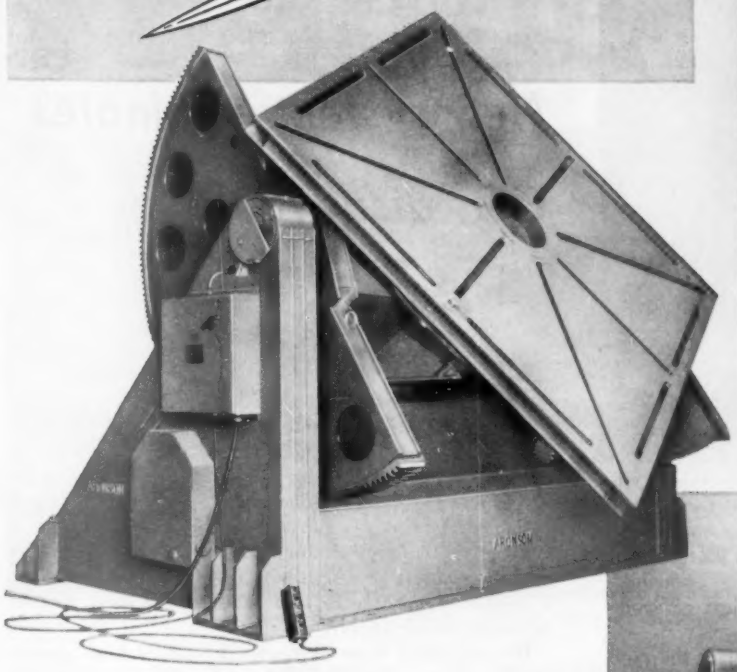
4—When the weldors shut off their current, this steel mill manipulator will be 1 in. thicker. That much hardfacing material will be spread over an area 36 ft long and 3 ft wide. First pass is laid with a low-hydrogen E7016 electrode to insure good bonding. Subsequent passes were with E6012 mild-steel electrodes topped with three passes with a medium-alloy iron-powder type. This hardfacing metal is very tough, moderately abrasion-resistant, and can be machined.

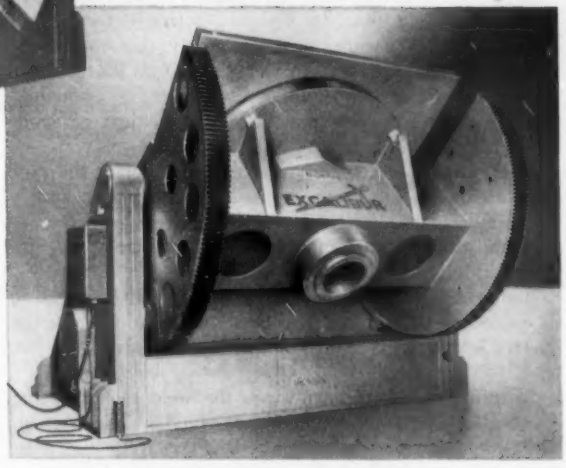


5—Tractor rollers take a terrific beating. This one will have its life extended many times by manual hardfacing. Weldor is using a medium-alloy iron-powder electrode for both build-up and hardfacing layers, reportedly depositing metal 35% to 45% faster than conventional high-carbon electrodes previously used.

EXCALIBUR.....

Welding Positioner 175 TONS CAPACITY





"EXCALIBUR" is rated 350,000 pounds Load Capacity with CG 12" above table and 6" off-center.

FOUR SELECTIVE VARIABLE SPEED RANGES obtained from the 4-speed gearshift transmission driven by 15 hp Varidrive afford far greater choice of variable rotation speeds. In High Gear top speed is .4 rpm adjustable to .07 rpm. This exceptionally high rotation speed permits automatic welding at high travel rate on diameters as small as eight inches! Then, for larger diameters shift into 3rd Gear and use the .23 rpm to .04 rpm range. Or, still larger work may require 2nd Gear's .13 rpm to .023 rpm range. Largest weldments are profitably rotated in Low Gear range's .08 rpm to .013 rpm.

"EXCALIBUR" is not physically tremendous, being only 88" from floor to horizontal rotation axis, which allows working both large and small weldments without needing excessive headroom and without working too high above the floor.

"EXCALIBUR" has been designed to handle almost every kind of weldment at lowest possible shop cost.

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Owning **"EXCALIBUR"** lets you weld automatically those jobs you now wrestle around the shop floor with the profit-eating crane and have to weld manually.

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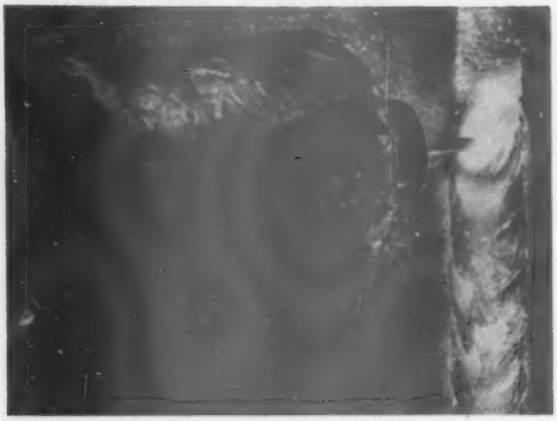


CLOSE-up of dip transfer arc while making a vertically-positioned butt joint in ¼-in. plate.

New system eliminates CO_2 disadvantages

A NEW SYSTEM for CO_2 welding, designed to minimize disadvantages of the process, was introduced at the annual Welding Show by Air Reduction Sales Co.

Termed "dip transfer," the method's principle is the transfer of weld metal by a wiping action at the time of short circuit. According to the company, this pulsing arc (up to 200 contacts per second) will reduce inherent disadvantages of carbon dioxide welding on mild and low-alloy steels, *i.e.*, weld spatter, loss of critical electrode elements, high heat input.

The moving electrode comes in contact with the pool and creates a short circuit load on the power supply (which has an inductance value that regulates rate of rise and decay of current), causing a current upsurge to a very high value.

Before the surge reaches maximum peak, overheating is caused by current-flow resistance at the point where the electrode enters the pool.

Surface tension then wipes the weld metal off the electrode. (See A in the figure.) Aided by electromagnetic pinch, contact is broken and a relatively high current arc is established. This sequence results in spatter-free metal transfer.

Dissipation of the electrode-melting energy is accomplished by a transient voltage (caused by rapid breaking of an inductive power supply under static conditions). The arc develops considerable force, creating a depression in the pool. (See B in the figure.)

As energy is discharged to the arc, voltage and current decay; forces on the weld pool decrease, and the melting electrode advances toward the work.

Arc length, therefore, decreases and electrode and pool again come in contact. (See C and D.) The liquid drop is then transferred to the pool and the cycle repeats itself.

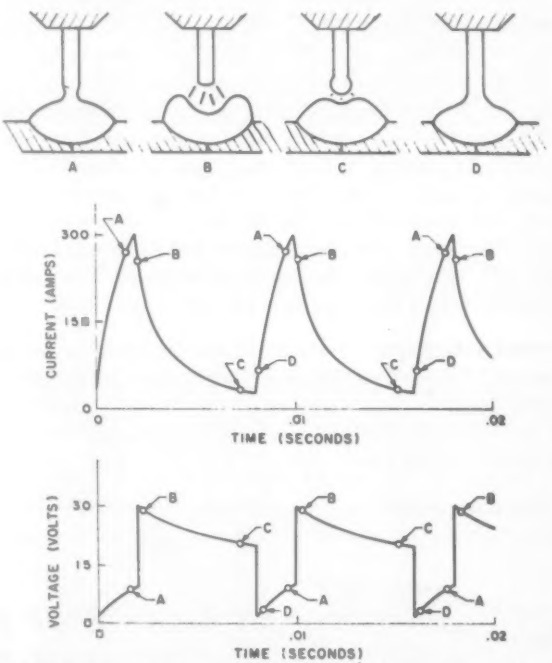
Cycle time is uniform and, under desirable conditions, will repeat between 100 and 200 times per second. Circuit inductance and the power supply's voltage setting control the cycle.

Factors determining proper inductance are wire diameter, electrode extension and wire feed rate. Correct correlation of these three will determine weld quality and result in strong-bonded, spatter-free welds, the firm states.

Dip transfer is most practical at current levels below 200 amp and these currents are best used with small diameter wire, preferably less than 0.045 in. With fine diameter wire and low energy input, the weld pool remains small and easily managed.

Short extension (less than ½ in. from gun to arc) is another determining factor and results in higher frequency and less spatter loss. More important, however, a greater range of wire feed rates can be used without adjusting power supply.

By combining these elements—low-arc voltage, power supply design, low current, small diameter wire and short extension—the company feels mild and low-alloy steels can be welded easily on a practical, economical basis while using CO_2 as a shielding gas.

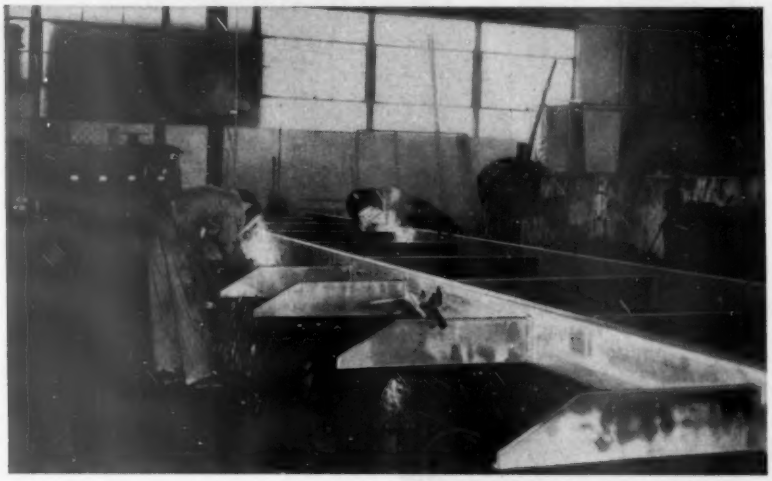


SCHEMATIC of mechanism of metal transfer (above) and voltage and current wave forms associated with the new CO_2 system.

Lincoln

WELDYNAMICS

NEWS ABOUT ARC WELDING AT WORK CUTTING COSTS



Sixteen 50-foot coach frames are assembled, welded and painted on this jig in one day.

SWITCHES ELECTRODE . . . SAVES $8,000

Guerdon Industries, Inc. of Newton, Kansas, builders of "Great Lakes" mobile homes, have doubled welding speed on undercarriages by a seemingly simple switch of electrodes.

Actually, the change was made as a result of a painstaking study by Ken Rymer, Guerdon's Welding Foreman; James Mandrut, Plant Superintendent and Bob Clemens, Lincoln's welding engineer in the area.

The frames consist of 13 gauge formed cross members welded in a jig to 12 gauge channels which form the longitudinal members. Length varies from 14 to 50 feet. Welds are made in vertical down and flat position and are of short duration thus requiring good restrike characteristics. The electrode also must combat light scale and oil.

Tests proved that Fleetweld 37, Lincoln's E-6013 electrode at 250 amps was twice as fast as the E-6010 rod previously used. Also cleaning time was greatly reduced because Fleetweld 37 has very little spatter.

At the present time, Guerdon's Newton plant turns out 16, fifty foot frames a day on one jig. Savings are averaging over $8,000 per year over the previous method.

Fleetweld 37 electrodes are ideal for short, high speed welds. Light rust and oil are no problem.

Mr. Mandrut states, "We look on Bob Clemens as our own welding engineer. He's always ready to tackle and solve our welding problems."

For help with procedures and cost reduction ideas, call your Lincoln welding engineer today.

Guerdon's Jim Mandrut, "Lincoln engineering service is outstanding."

WELDIRECTORY AIDS ELECTRODE SELECTION

Matching the electrode to the job for the most efficient welding is greatly simplified by the new Weldirectory of Mild Steel Electrodes.

Electrodes are grouped according to performance characteristics, and each electrode is discussed individually so that the user can determine exactly which electrode best suits his purpose.

A copy may be obtained by writing to The Lincoln Electric Co., and requesting Bulletin 7000.1.

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Will these . . .

TWO types of transducers for ultrasonic generators. At left is conventional magnetostrictive type; at right is a new spaced-lamination design recently unveiled by Westinghouse. Ultrasonic welding is not new, but use of ultrasounds to improve quality of conventional arc welds is foreseen by Battelle Memorial Institute researchers.

improve this?

ULTRASONIC VIBRATIONS have been enlisted in many ways—to wash dishes, mix paints, drill teeth, check for flaws, and even to weld.

Now these ultrasounds are seen as aids in improving *conventional* welds. A recent report by John N. Antonevich and Robert E. Monroe, research scientists of Battelle Memorial Institute, Columbus, Ohio, indicates that stronger weld joints result when ultrasound is used to vibrate metal at the site of the weld during the joining process.

Experiments with these vibrations have revealed potential benefits for resistance welding, brazing, but especially, arc welding. Surface tension of molten metals is reduced, permitting more intimate metal-to-metal contact.

Weld-weakening gas bubbles are driven out. Growth of crystal structures, which make welds brittle, is inhibited. In resistance welding and brazing, vibration can promote intimate contact of the metals by removing oxides and other surface contaminants.

Certain problems, say Antonevich and Monroe, must be overcome by research before ultrasonics can be combined with conventional welding, however. For example, ultrasonic vibration increases cooling rates of molten metals, and the weld may freeze too soon for desirable effects to occur.

Then, too, increased reaction rates

may accelerate such effects as undesirable alloying. Means must also be found to deliver the necessary amount of energy to vibrations at the weld zone.

Apart from the possible use of ultrasonic energy in combination with conventional welding methods, increasing promise is shown by the distinctive ultrasonic technique already being used in some industrial welding operations. (See *Ultrasonic welding comes of age*, WELDING ENGINEER, December, 1958, p. 52, and *Ultrasonics: a "sound" welding technique*, October, 1958, p. 52.)

In this process, the parts to be joined are forced tightly against each other. A tip, vibrating in the ultrasonic range, is pressed against the spot to be welded, usually for less than three seconds. This imparts vibration-producing frictional heat at the surface to be welded.

The heat, plus the clamping force, causes a bond. The precise nature of this bond is still being studied—it may be fusion between surfaces, cohesion from intimate contact, or both, according to the authors.

An enticing possibility of ultrasonic welding is that it can be used to weld dissimilar metals—molybdenum to steel, for example. With usual methods, excessive melting and diffusion of the two dissimilar metals often produce compounds which cause low shock resistance and ductility. This does not occur with ultrasonic welding.

Surface contamination is another problem alleviated by ultrasonic welding. One company welds insulated aluminum to copper foil. Vibration quickly destroys the insulating material at the weld and the bared metals make contact. Surface oxides and microscopic peaks are removed, making the contact more intimate.

Experience with ultrasonic welding shows it can be used for butt, seam and spot welding to join small components of thin-gage sheets of moderately ductile materials. All materials which can be pressure welded probably can be ultrasonically welded.

Further research is expected to lead to more applications of ultrasonic welding and ultrasonics *in* welding.

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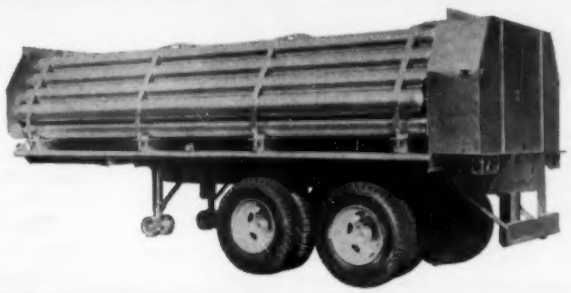

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CYLINDERS TUBES FLANGES COUPLINGS

Welding Engineer metals meet round-up

Explosive forming, missiles covered at Western congress

New records in sales from the floor were set in the Pan-Pacific Auditorium, Los Angeles, during the recent 11th Western Metals Exposition. Top sales of $750,000 and $200,000 were reported.

Attendance for the show reached 60,000. Some 6,000 persons gathered to hear technical papers at the Western Metals Congress.

"AN INCREASING NUMBER of authorities believe explosive metal working is the only practical approach to production on close tolerance, heat resistant, high strength parts."

So says John A. Haynes, National Northern Corp., subsidiary of American Potash & Chemical Corp., West Hanover, Mass. He made this statement at a session of the American Society for Metals during the recent 11th Western Metals Congress in Los Angeles' Ambassador Hotel.

"Explosive forming is an appealing process," says Haynes. "It forms shapes not economically possible by other means. Large savings may be realized through less complicated and less expensive tooling. Springback is almost eliminated."

He stated that his company is applying explosives to welding and forging. (See *WE*, April, p. 61.)

At another session, Dr. John S. Rinehart, professor of mining engineering, Colorado School of Mines, Golden, Colo., said, "The great potential of metal forming by explosive charges has just been tapped."

Though almost every phase of the welding and metals industries was covered at the congress, missiles and high speed aircraft were emphasized.

Basic steps in conducting a welding experiment were outlined at an AWS meeting by J. E. Hurzeler, North American Aviation Inc., Los Angeles.

He said that proper design and thoughtful organization of a welding experiment is necessary to produce accurate data. Five basic steps were suggested:

—State basic concept and objective, review project with others to eliminate one's personal bias, perform the experiment, draw a conclusion and write a covering law.

Two engineers of Hughes Aircraft Co., Tucson, William Sponheimer and P. C. Simmons, presented a joint paper describing the automatic Tig welding of hemispherical sections for pressure vessels.

The vessels are proof-stressed at a pressure creating internal wall and weld stresses approaching 87% of the ultimate tensile strength of the metal. Use of the Tig welding method resulted in less than 1% rejections in high speed production.

William P. Kraus, missile division, North American Aviation Inc., Downey, Calif., said increasing dependence upon resistance spot and seam-welded joints for primary structures in missiles and high-speed aircraft emphasizes the need for realistic design criteria.

The term "tension" applied to spot-weld loading does not adequately describe the complex peeling action which actually occurs when a spot-welded joint is tension-loaded normal to its contracting surface.

"For many years the term "tension" has been associated with spot welds as a criterion of weld quality . . . The goal of previous investigators seems to have been pursuit of pure tension loading as an evaluation tool rather than development of realistic design data."

Speed advantages Mig welding holds over Tig welding in the manufacturing of external fuel tanks for high speed jet aircraft was explained at an AWS session by R. K. Longerbeam, Royal Industries, Alhambra, Calif.

He said his firm has eight Mig welders joining 5,000 linear feet of light gage aluminum alloy during an eight-hour shift. Inspectors find an average of one leak per every 40 ft of welding.

During one session conducted by the Society for Nondestructive Testing, the lack of skilled persons to disseminate nondestructive test methods was discussed.

Dr. G. H. Tenney, Los Alamos Scientific Laboratory, N. M., said that while nondestructive testing has developed rapidly over the past 10 years, there are still practically no formal educational institutions teaching it.

Richard Hochschild, Metrol Inc., Pasadena, told one group that manufacturers are adapting radiation, ultrasonic, magnetic and eddy current testing processes to provide 100% inspection of every part that goes onto a plane, rocket, satellite or missile.

During the congress, the ASM and AWS held several joint sessions. At one such meet, Arthur J. Williams, Consolidated Western Steel Div., United States Steel Corp., Los Angeles, discussed weld quality.

He said porosity and cracking of welds in X-200 high-silicon, high-carbon steels for skins on high altitude aircraft and missile pressure vessels has been virtually eliminated.

A two-pass Tig welding technique, working from one side on an inert gas back-up, has stopped porosity. The first weld laid is a section of filler wire of the same material as the parent metal. The second weld fuses-in and compacts the joining material.

A new series of magnesium alloys for high temperature service has been developed by Dow Chemical Co. Harlan L. Meredith, Airline Welding & Engineering, Hawthorne, Calif., talked about the new alloys.

He said the materials consist of such alloys as thorium-zirconium-magnesium, thorium-manganese-magnesium and rare earth metal zinc-zirconium-magnesium.

Meredith urged manufacturers to become familiar with the weldability, formability, machinability and heat treatability of the materials before applying them.

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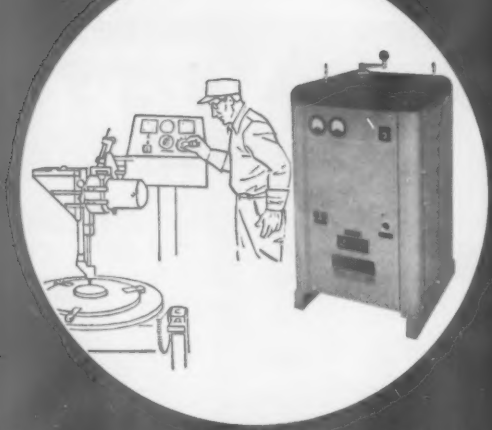

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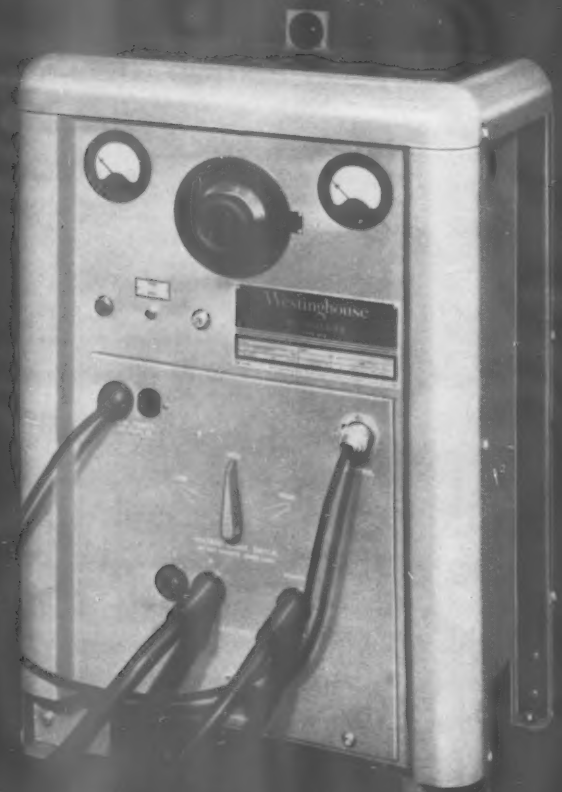

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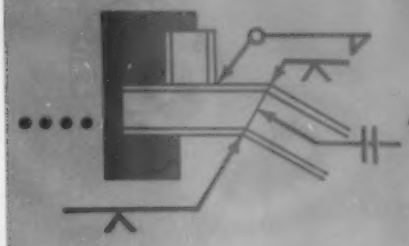

the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

How to dip braze aluminum

Question:

Could you describe what aluminum dip brazing is, and summarize the process?

Answer:

Dip brazing is so termed because joining is performed by dipping the complete assembly into a vat of heated flux. It is a brazing operation because the filler metal, an aluminum alloy, melts at a temperature slightly lower than the melting point of the aluminum parts to be joined.

During brazing, the filler metal flows into gaps between the closely fitted surfaces of the joints by capillary action. The use of pre-placed pieces of filler metal and the extremely low viscosity of the molten flux ensures the production of perfect joints in locations which are completely within the assembly, and can neither be seen nor reached from the outside.

Cleanliness is the most important single factor in the aluminum dip brazing operation. During brazing, parts must be clean to ensure a good joint, and after brazing, flux must be removed to eliminate any possibility of corrosion.

To clean parts to be brazed: degrease parts, immerse in a caustic acid and rinse. Immersion in a neutralizer, rinsing, immersion in an acid, and rinsing again, follow.

Next, the parts are assembled. Preformed pieces of brazing alloy are placed at all points where a joint is desired. The complete assembly is either held together by stainless steel clips, a fixture or are tack welded.

The entire assembly is slowly and uniformly preheated to 1,000 F. It is then submerged in heated flux from 45 seconds to 2 minutes, air cooled, and finally dipped in 212 F water, and rinsed.

To remove flux, unit is neutralized in an acid, rinsed, dipped in dichromate and nitric acid, and rinsed again.

If the above procedure is followed, according to Meridian Metalcraft Inc., Whittier, Calif., the dip brazed joint produced in a correctly designed aluminum dip-brazed assembly will be from 80 to 100% as strong as the parent metal.

Corrosion resistance will be at least as good as for other types of joining, and warpage due to uneven heating, completely eliminated.

* * *

From time to time, WELDING ENGINEER *likes to present new processes on this page which WE think will be of interest to our readers. The following is such a process.*

Robert Pursell of Stone & Webster Engineering Corp., New York City, has recently patented a method which allows inexpensive application of inert gas welding of pipe in the field.

Important components of this process are 50-lb kraft wrapping paper and masking tape.

In the past, use of inert gas on pipe in the field has been limited because of the difficulty of retaining the gas in the weld area, or of getting rid of the retainer.

In the new method, a circular piece of kraft paper is taped as a baffle 6 in. from the pipe ends to be joined. The paper is capable of withstanding welding heat up to 600 F, and 3 to 4 oz per in. of pressure exerted by the inert gas. After welding, and during annealing or stress-relieving, both the paper and tape disintegrate, leaving a clean pipe.

The paper is only part of the complete system. The entire operation involves preheating of pipe ends, use of holding apparatus (Fig. 1), welding roots without filler in inert gas atmosphere (Fig. 2), and visual inspection of internal bead.

Welding in either horizontal or vertical positions is allowed by the process. And, experiments have shown that quality welds are obtained without rotating or otherwise shifting pipes during welding.

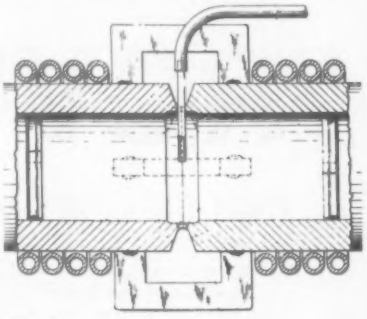

Fig. 1.

END sections of two lengths of pipe, showing bracketing device, tube for injecting inert gas, heating coils and baffles inside pipe.

FIG. 2 shows positioning of apparatus for arc welding root in inert gas atmosphere. Fig. 3 is view of first bead after completion of root weld. Fig. 4 shows successive beads of weld metal with lower layers applied completely across modified V groove and bonded to both side walls and previous bead.

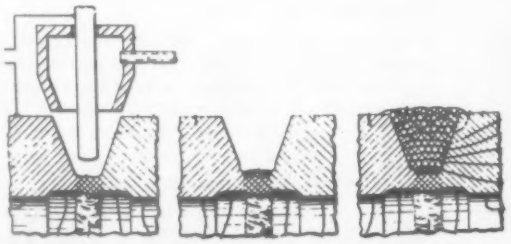

Fig. 2. Fig. 3. Fig. 4.

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These are a few of the reasons why it will pay you to look into HAYNES Hard-Facing Machines. Our field engineers can help you determine which of your hard-facing jobs are suitable for mechanization. For full information on HAYNES Mechanized Hard-Facing Machines and on the wide range of HAYNES Hard-Facing Alloys, write our general sales office in Kokomo, Ind.

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THE ORNAMENTAL IRON CO-OP

P. O. Box 10085 Memphis, Tennessee

For Mig welding . . .

Extruded uranium welding wire proves best

by **E. L. Brundige, G. S. Hanks,** and **J. M. Taub**
Los Alamos Scientific Laboratory

FABRICATION OF URANIUM welding wire in suitable sizes became necessary with the introduction of Mig (metal inert-gas) uranium welding.

Production of this wire while still retaining similar and reproducible characteristics was the main problem to be solved. A low impurity content was essential, especially the iron content. After investigation of various fabricating methods, extrusion of cast uranium billets proved best for meeting requirements.

A modified electric furnace preheated the billets prior to extrusion. To provide an inert atmosphere during heating, the following modifications were made: a stainless steel liner in the muffle, a graphite floor in the liner, a graphite door at the liner front with a gas manifold on the other three sides, and a gas curtain at the furnace door.

After extrusion the uranium rod was swaged to the required diameter.

Uranium metal exists in the gamma phase between 770 C and uranium's melting point. In this phase uranium metal is extremely soft and plastic and will deform easily at relatively low temperatures.

To insure uranium remaining in this gamma range during the entire process, extrusion temperature was maintained between 1,000 and 1,050 C. The inert atmosphere during heating prevented oxidation.

Standard vacuum melting procedures for uranium were used to make the melt, which was then poured into graphite molds. Numerous castings (single billet, vertical, horizontal and (circular gang) were made, however, the majority were single billet.

Ingots were first halved with a power saw, then shot blasted on all surfaces. (This eliminated a costly machining operation.)

The 6-in. long billets were placed in the furnace, 10 per load, and a flow of 10 cfh helium and 0.1 cfh argon was directed through the stainless muffle. Billets were soaked at least 40 minutes at 1,050 C.

For the extruding operation, shear-type dies were fabricated from high-speed steel. These dies were not heat-treated, however.

Hardened and hardfaced dies had been used, but hardened dies had a tendency to wash out or crack during extrusion (one die lasting for only four to eight extrusions). Non-hardened dies were no better (replacement every second or third billet).

Because of these short service lives, lubricating experiments were conducted. Numerous commercial and compound lubricants were tried, but soft glass proved best.

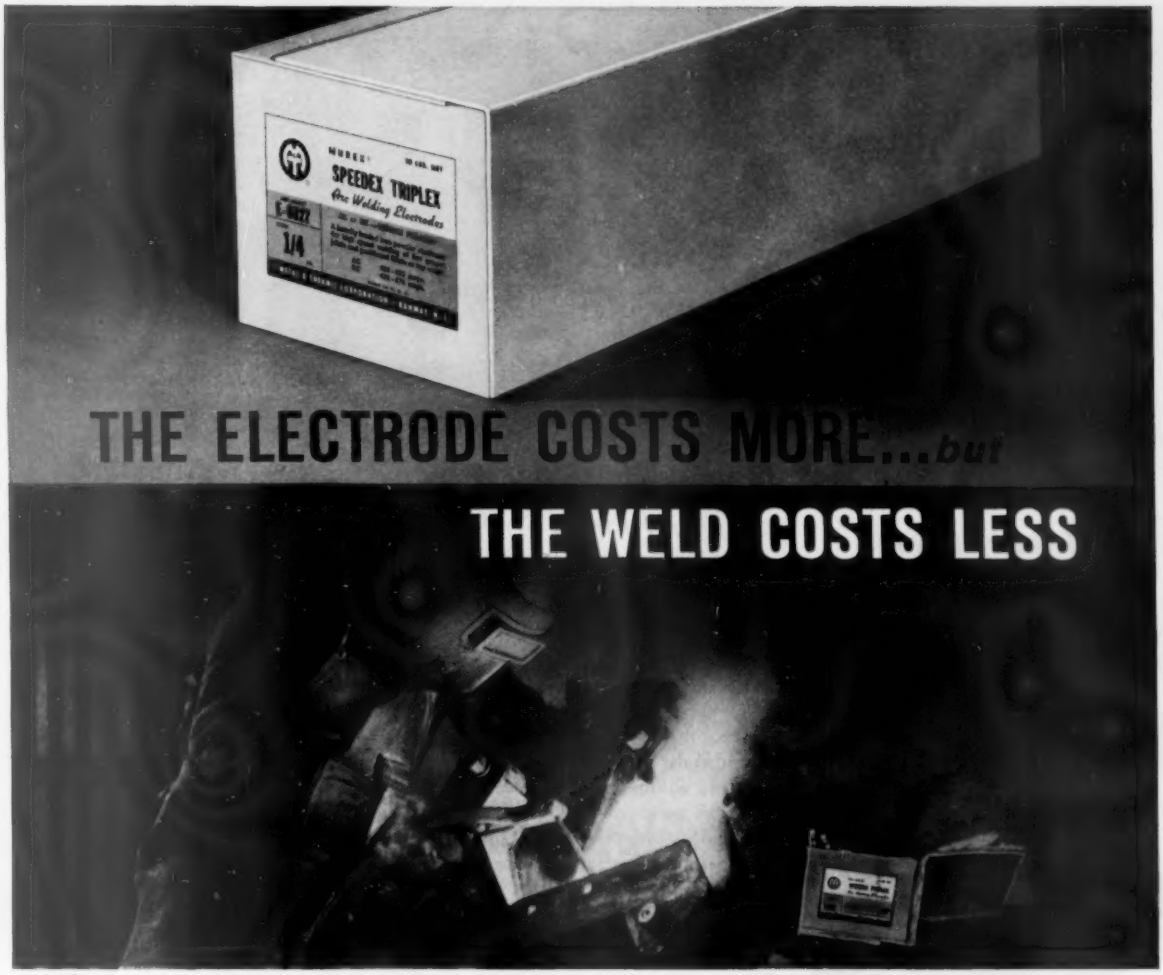
This lubricant was wrapped around the billet, and a small amount placed inside the billet chamber, while the die was stick lubricated. The combination was satisfactory and service life increased to more than 50 billets.

As the ¼-in.-diameter rod left the press, it was coiled manually. Addition of salt, plus the glass lubricant adhering to the wire, helped prevent any severe oxidation.

The extruded rod was then washed with water, brushed to remove excess salt and glass, and dried. It was then salt annealed, straightened and swaged to the desired diameter.

After swaging the wire was again coiled over a 14-in.-diameter graphite mandrel. (Wire was heated to a dull red, about 250 C, by an oxyacetylene torch to facilitate winding.) Degreasing, oxide removal and silver plating (4 to 6 mils) followed.

If desired, the plated wire may be swaged one to two mils smaller than the plated diameter to improve adhesion. The wire is then ready for use as filler in Mig welding.



See how downhand welding costs go down with Speedex Triplex iron powder electrodes

Comparable electrodes:	Conventional 5/16" E-6020	1/4" Triplex
Electrode cost per lb.*	$0.160	$0.220
Melt rate, lb. per hr.	16.60	22.40
Cost of metal melted per hr.	$2.656	$4.928
Deposit rate, lb. per hr.	11.75	17.31
Metal cost per lb. of deposit	$0.226	$0.285
Average hourly labor cost	$2.51	$2.51
Labor cost per lb. deposit	$0.213	$0.145
Cost of labor and electrodes per lb. deposit.	$0.439	$0.430

Now add your overhead and the faster production makes the saving all the more substantial

*1,000-20,000 lb. price

WITH heavy weldments that can be fabricated in the downhand position, a cheaper electrode proves no real economy. Not when you can deposit better than 17 pounds of metal per hour for a lower *end cost* with Speedex Triplex electrodes.

Compare the representative figures on comparable electrodes. No question but that you save money.

Fastest of the MUREX® line, Speedex Triplex modified E-6027 electrodes have an extra heavy iron powder coating. They produce X-ray quality welds with either drag or open arc technique. Ask the MUREX Man about them. Or send for bulletin. METAL & THERMIT CORPORATION, Rahway, New Jersey.

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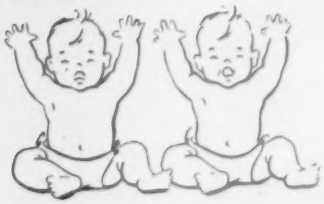
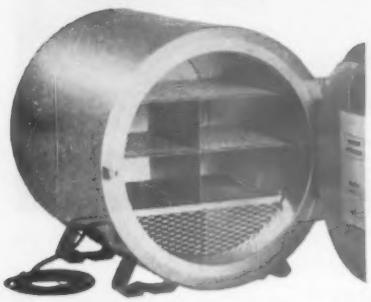


Moisture "messes up" electrodes, too, cuts welding profits.

End costly reworks by drying rods in

DryRod® OVEN



Mineral coated electrodes are *thirsty*. The instant you unpack them they start soaking up moisture . . within 2 hours often as much as 13 times US allowable specifications. Moist rods cause porosity, under-bead cracking, rough welds, etc. Rod scrap runs high Production slows down. Reworks eat up profits.

Storing rods in DRY-ROD OVEN prevents such losses, insures faster, finer workmanship at less cost.

Write for new literature on latest rod-drying methods, "Dry Rod as Standard Welding Equipment."

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COMPLETE brazing unit (left) shows finished assemblies being removed from link fixtures by ejector at right side of machine. Unit is approximately 12 ft in length.

Mixer blades induction brazed at a 1,200-per-hour clip

by **Irving A. Greenfield**

THE NEXT TIME you watch your wife whip potatoes with her electric mixer, you may be seeing a welded product at work. If it's made by Sunbeam Corp., that mixer will have brazed beater blades.

Officials of this Chicago firm have found brazing to be a clean and efficient joining process—fast, too, since they employ a versatile induction heating unit to handle blade assemblies. This machine, manufactured by Induction Heating Corp. of Brooklyn, incorporates a 20-kw generator, a work station and a conveyor in a single installation that can be operated by one man.

Four pre-shaped blades and a stem are the components fed into the brazing machine. They are turned out at the remarkable rate of 20 units per minute—1,200 per hour.

First step in the operation is one of riveting blade ends to the bottom of the stem. Farther up the stem is a groove into which the other ends of the blades are fitted. A 0.031-in.-thick ring of BAg-1 (45% silver) alloy is then slid into place at the groove.

LOADING station where assemblies are placed in link fixtures.

Following an extra-heavy application of flux to prevent oxidation and discoloration, each assembly is manually loaded into its individual fixture. All fixtures are attached to the continuous link conveyor, and the lower four sections of a beater assembly are accommodated in each link.

As assemblies progress along the conveyor, each is forced snugly into position for brazing by a coil alignment fixture. After alignment, assemblies pass into an 18⅜-in., single-turn, hairpin-type conveyor work coil where the induction generator heats units and brazes blades to stems.

Brazed assemblies are moved by conveyor into a spray-bath chamber. Each unit passes between two pressurized hot-water sprays which rinse excess flux and extraneous foreign matter from them.

When a finished assembly reaches the end of the conveyor, it is removed from its link fixture by an automatic ejector. The moment the link conveyor starts to turn downward, a beveled collar on the beater slips into the beveled channel of the ejector. Completed assemblies drop into a tray and are then available for other operations.

The new rugged, powerful Riley Pulverizer is an outstanding example of advanced functional design. A key to this Riley pioneering achievement is the use of tungsten carbide to increase the life and efficiency of pulverizer parts. Result . . . years of uninterrupted performance . . . minimized shut-down time . . . lowest operation costs.

Needless to say, pulverizers take tremendous punishment, but these are definitely built to "take it." *Riley specifications assure prolonged service.* The tungsten carbide facings are brazed to the pulverizer parts with Silvaloy—producing joints *as strong and dependable as the metals joined.*

Silvaloy Brazing Alloys and APW Fluxes are helping to speed production, lower costs and improve brazing results in many fields. Call your nearest Silvaloy Distributor for information or assistance.

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RILEY STOKER CORPORATION

Riley pulverizers have been selected by many of the leading public utility and industrial companies for pulverizing coals of high grindability and abrasive high ash coals. The use of tungsten carbide as a facing for the pulverizing elements assures low maintenance, long continuous periods of operation, and sustained fineness with high availability.

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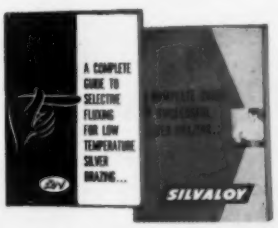


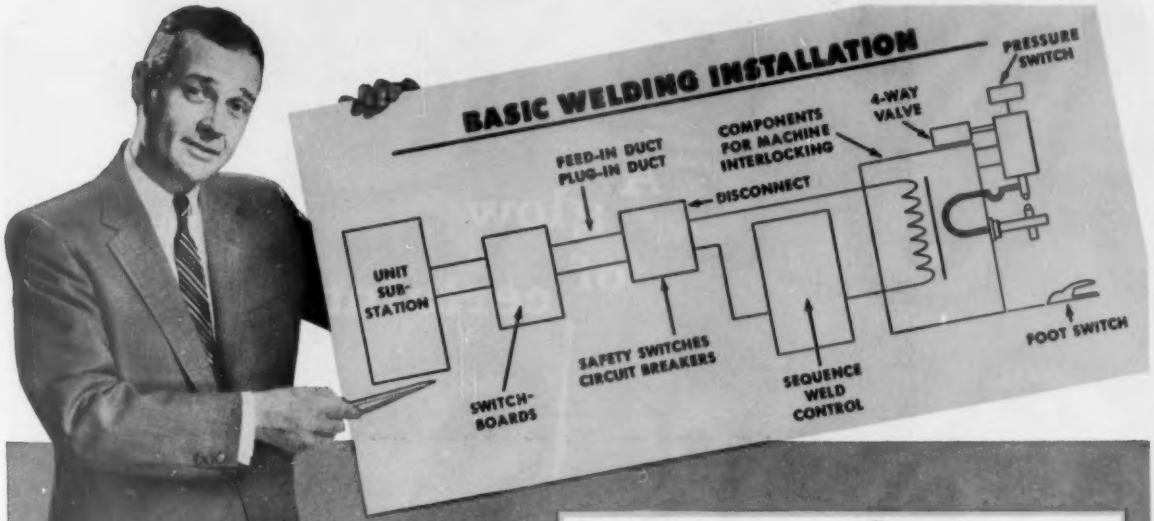
Two complete reference manuals for low-temperature silver brazing and fluxing are available upon request. Send for either one or both. ★ ★ ★ ★ ★ ★ ★

WELDOR works on advanced engines for Air Force Titan missiles at Aerojet-General Corp.'s Liquid Rocket Plant, Sacramento, Calif. Technician is silver brazing skirt area of thrust chamber. Chambers are made of tapered hollow stainless steel tubes which provide missile with lightweight, high-strength components capable of withstanding extreme high temperatures. On right, workman Tig welds chamber throat area. Tubes used in chamber construction are first placed on a form, and then brazed and welded in place. Titan is a two-stage intercontinental ballistic missile.

RYAN Aeronautical Co. is installing a complete high energy forming facility at its San Diego plant after successful experimentation with explosive forming of jet engine parts. Some components are formed with process in 15 minutes, as compared to 8 to 10 hours needed by other methods. In process, metal part is placed in die and assembly is lowered into water-filled pit. Explosive charge is positioned in die. When detonated, water pushes against part, forcing it into shape of die. Water then blows out top like geyser (below). Above, perfectly formed jet engine part, at left, made from blank like one at right.

On the job...

FUEL tanks for Boeing Airplane Co.'s IM-99 Bomarc missile will be produced by explosive forming in near future. Welded tanks of high-strength steel alloy will be used. After heat-treating, tanks will be placed in a two-piece sizing die and filled with water. Then, specially mixed TNT-like charge will be lowered into flooded tanks and remotely set off by electric detonator. Blast molds welded-steel tank to close tolerance and aerodynamic smoothness required in missile production. In all tests, welds have withstood pressures created by explosives.



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Field Engineers are available through Square D branch offices in all principal United States cities—and in Canada, Mexico and England. Backing up these engineers are the design and manufacturing facilities of 14 strategically located Square D factories and the localized services of a nation-wide network of authorized electrical distributors.

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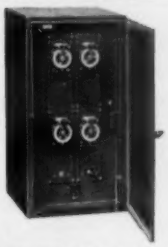
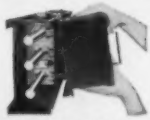


ELECTRONIC and MAGNETIC WELDER CONTROL

SUBSTATIONS

SWITCHBOARDS

FEED-IN DUCT



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SAFETY SWITCHES

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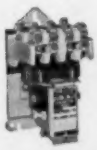
PRESSURE SWITCHES

4-WAY VALVES

PUSHBUTTONS

SELECTOR SWITCHES



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Try *ANSCO SUPERAY 'A'*. It's a fast, fine grain emulsion, specifically designed to record high contrast images of the smallest defects in either light or heavy materials with gamma or x-rays.

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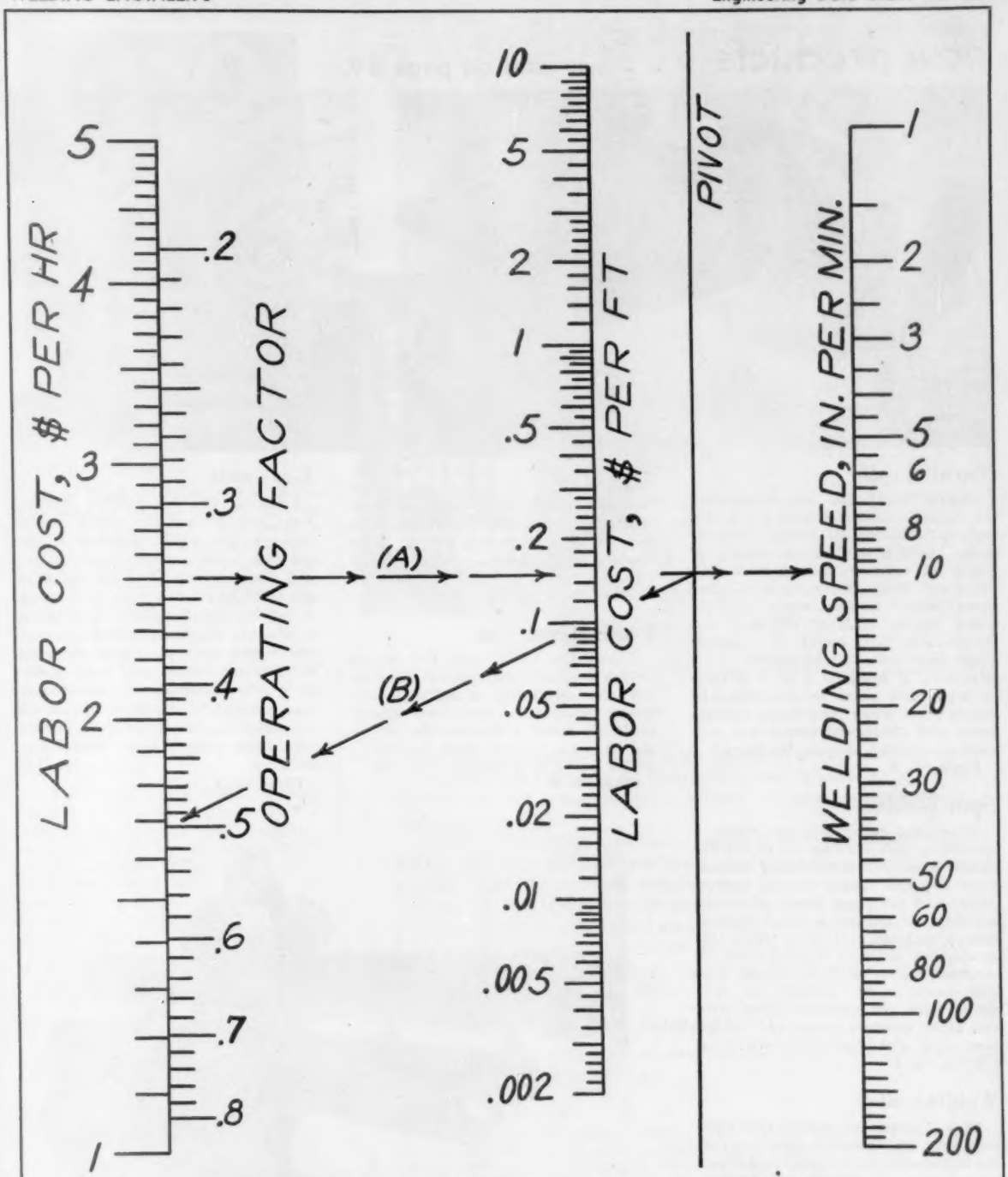


COMPUTING WELDING LABOR COSTS

by **Steven D. George**

Compute the labor cost per foot of welded joint in any type of work with this chart, which correlates hourly labor costs, welding speed and the operating factor.

Example: What is the labor cost per weld foot on a job where hourly labor rate is $2.50, welding speed is 10 ipm, and operating factor is 0.5?

Solution: Enter the chart on the left at the hourly labor cost ($2.50) and draw a straight line through the welding speed (10 ipm) on the right. From the intersection of this line with the pivot, draw a straight line through the operating factor (0.5) on the left.

At the intersection with second scale stem from the left, read the labor cost as $0.10 per foot of weld.

This chart can be uesd for any type of welding, if the three factors plotted are known or can be assumed. The chart is based on $L = 12H/60(SF)$, where L= labor cost, dollars per foot of weld; H = hourly labor cost, dollars; S = welding speed, ipm; F = operating factor.

(Note: if the operating factor is expressed as a percent, it is changed to a decimal before entering.)

new products . . . use card on page 89

Turning rolls

Models WSD400S1G and WSD400S2G are turning rolls for automatic and manual welding of cylindrical vessels. Used together, units provide smooth rotation of heavy wall vessels for welding or cladding. Hardfaced 30 in. OD, precision machined wheels with 7 in. faces, safely and accurately support loads of 400 tons, says manufacturer. Rolls provide four selective speed ranges from 4 to 80 ipm for smooth positioning of vessels in 3 to 14 ft range or larger. Slave motors are synchronized by remote power source. Anti-friction bearings, heavy plate chassis and welded steel gearcases are included. *Aronson Machine Co.*

Circle No. 1

Spot Welder

Air-operated rocker arm type welder is available in capacities from 7½ to 75 KVA. Welder is equipped with following features: heavy duty heat selector with full load capacity, extra heavy rear switch rod, contact assembly, air cylinder, standard electrode holders, electrodes, and Morse tapers. Unit is completely air cooled. Standard model has maximum spacing of 12 in. between arms with special models available for 48-in. throat depth and adjustable lower swivel arm having maximum spacing of 28 in. between arms. *Alphil Spot Welder Mfg. Corp.*

Circle No. 2

Welding alloy

Alloy of copper and zirconium for resistance welding is claimed to have exceptionally high electrical and thermal conductivity, coupled with high strength and hardness. Properties of material, Mallory "28" metal, display unusually good resistance to annealing or softening, and ductility is such that alloy should not check or crack when highly stressed at high temperatures, according to manufacturer. *P. R. Mallory & Co., Inc.*

Circle No. 3

Safety spectacle

Tutone-frame safety spectacle is designed for needs of plant management, visitors, and personnel not directly engaged in activities requiring heavier eye-protection. Frame is sheet stock cellulose acetate butyrate, features a universal bridge which will fit over 90% of potential users, according to manufacturer. Interchangeable S7 lenses are pierce and impact resistant, and barrel hinges eliminate temple rocking. *Glendale Optical Co.*

Circle No. 4

Professional film

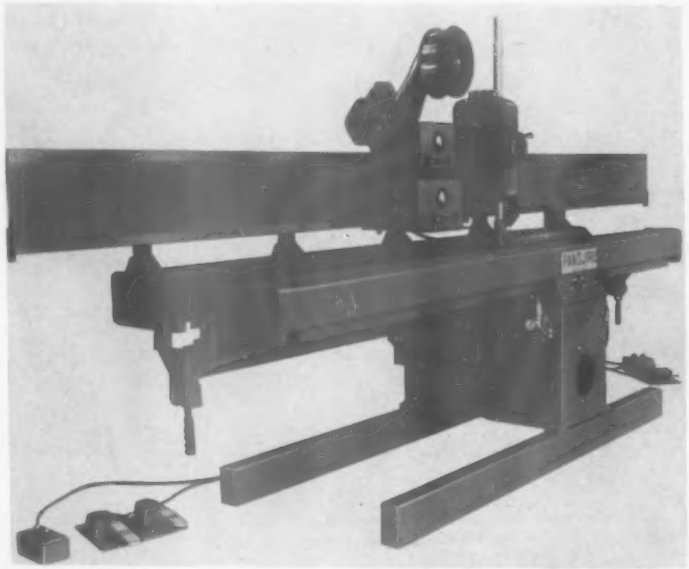
Transparency film (Process E-3) is said to have finer grain and improved definition and color reproduction, in addition to permitting picture-taking under lower lighting conditions. Speed of the film—daylight 50 and tungsten 32—will make possible a smaller lens aperture. *Eastman Kodak Co.*

Circle No. 5

X-ray unit

Baltograph 180, Panoram-X is industrial X-ray unit designed for widest possible variety of radiographic inspection of pipe and tank welds, castings, assemblies and steel structure work. Essential feature of unit is 180 KVP-5 MA X-ray head, capable of 360 deg internal radiography as well as examination of circumferentially arranged outside work and spot or single beam use. Weighing only 111 lbs and measuring 40½ in. by 11⅝ in. diameter with handles, head is gas insulated, inherent filtration is low and penetration capability is up to 2¾ in. steel. Control unit weight is 41 lbs. *Balteau Electric Corp.*

Circle No. 6



Mandreled seamers

Both holding and clamping mandrels utilize same welding head in twin mandrel weld seaming fixture, which is said to achieve continuous arc time, maximum productivity and operational utility of one automatic welding head and power source. While welding cycle is taking place on one side of fixture, next piece is loaded in opposite side. *Pandjiris Weldment Co.*

Circle No. 7

Portable X-ray

Fifty-lb X-ray generator, small enough to pass through 6-in. opening but powerful enough to radiograph 1¼ in. of steel, is designed for quick on-the-job inspections by one man. Andrex 140 KV X-ray unit can be used to radiograph pipelines, pressure vessels, castings, aircraft, missiles, storage tanks, ships, and will operate on practically any available power supply line. It is claimed to be twice as powerful as conventional units of same rating. Consists of 50-lb generator and 55-lb control. *Picker X-ray Corp.*

Circle No. 8

Alloy plates

Jalloy Grade 3 heat-treated, abrasion-resistant alloy plates are now available in four hardness ranges, to facilitate specifying and make it easier to determine correct application for end use. Another variety, molybdenum-bearing Jalloy, will now contain copper, to provide additional resistance to atmospheric corrosion. Jalloy is an alloy steel designed for applications involving severe abrasion and/or impact. *Jones and Laughlin Steel Corp.*

Circle No. 9

Goggles

Stronger one-piece plastic eyecup which conforms to facial contours is principal feature of new welding goggles. More efficient anti-fog ventilation is also claimed. Full eye area receives maximum protection and all light sources outside of the lenses themselves are said to be excluded. Goggles are designed for use in all acetylene welding and cutting. *Sellstrom Mfg. Co.*

Circle No. 10

Here, in one compact bulletin, is the information that can help you choose the right cylinders for transporting and distributing all types of high-pressure gases—including oxygen, nitrogen, argon, ethylene and carbon dioxide.

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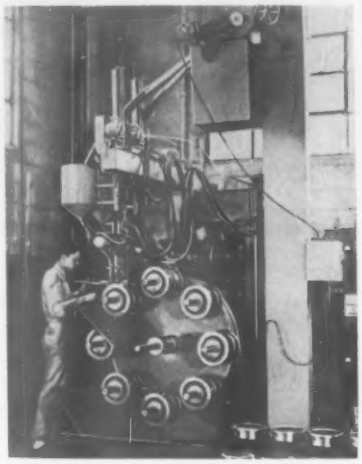
Flux circulator

Automatic flux circulating system eliminates manual handling of flux in keeping hoppers filled. Operator needs only to empty bag of flux periodically onto vibrating screen. Fused slag is automatically separated from unfused flux and put aside. Mechanical elevator picks up flux and lifts it to hoppers. *Sight Feed Generator Co.*

Circle No. 11



Roller rebuilder

Model MS-8 dual head automatic roller rebuilder features power operated controls throughout, hydraulic and electric. Company claims that one operator can do as much welding on this eight spindle machine as three to four operators using single spindle machines. Both sides of roller shells are built up simultaneously. Indexing from one roller to next requires only seconds of time, so almost continuous welding is achieved. Tilting mechanism also enables complete flange rebuilding. *Sight Feed Generator Co.*

Circle No. 12

Resistance soldering

Resistance soldering tool eliminates arcing and provides fast, void-free connections needed in aircraft and missile industries. Tool is completely automatic and adaptable to soldering multiple prong plugs. When soldering such plugs, the zirconium-tungsten electrode tip can be ground to conform to plug's pin shape. Unit is hand operated using an internal switch. It has a 400-volt transformer, hand tool and electrode. *General Electric Co.*

Circle No. 13

Weld shaver

Removal and finishing of weld beads by multiple grinding and sanding operations may now be performed in one operation with Weld Shaver. Unit utilizes rotary cutter to remove excess filler and shave weld beads to surface plane. Finger-adjustable indexing ring permits operator to increase or decrease cutter depth in increments of .0005 in. Blocking device fixes cutter position once proper depth has been reached. Exhaust air blows chips away from work and cools cutting head. Model ZT508, recommended for use on stainless steel, steel and titanium welds, is geared to operate at 3,000 rpm. Model ZT509, designed for use on aluminum, copper, brass and magnesium welds, operates at 11,500 rpm. In both models, power is furnished by 1 hp air motor, requiring 90 psi air supply. *Zephyr Mfg. Co., Inc.*

Circle No. 14

Articulated band machine

Fabrication industries in structural steel, shipbuilding, oil field equipment and heavy machinery may find Pan-Am Model 5 articulated band machine very useful because it can be used for both cut-off and shaping. Without repositioning the plates, tubing or structural shapes, they can be completely prepared for accurate welding. Second only to flame-cutting in cutting rate, this model is said to speed fabrication because of its clean, accurate cuts. Typically used for large fabricated weld fittings. *DoAll Co.*

Circle No. 15

Epoxy Adhesives

Thermosetting epoxy adhesives in Cepox 400 series produce an extremely tough, water-insoluble bond that resists most acids, alkalies and other chemicals. Developed for cementing cast iron, steel, copper, aluminum, bronze, plastics and other surfaces to themselves or each other, they are also used for sealing and filling gaps. They are said to have high impact, tensile shear, and compressive strength, and to not dry out, crack or deteriorate with age. Adhesives will not shrink, since they are made of 100% solids, with no solvent or diluent present. Cepox 401 produces a rigid bond, Cepox 402 produces a flexible bond with high peel strength. Both cure at room temperature. *Chemical Development Corp.*

Circle No. 16

Tempilstik°

*temperature indicating crayons**

*Also Tempil° Pellets and Tempilaq° (liquid form)

Tempilstik°—a simple and accurate means of determining preheating and stress relieving temperatures in welding operations. Widely used in all heat treating—as well as in hundreds of other heat-dependent processes in industry. Available in 80 different temperature ratings from 113°F to 2500°F . . . $2.00 each.

Send for *free* sample Tempil° Pellets. State temperature desired . . . Sorry, no sample Tempilstiks°.

Most industrial and welding supply houses carry Tempilstiks° . . . if yours does not, write for information to:

WELDING SALES DIVISION

Tempil° CORPORATION • 132 West 22nd St., New York 11, N.Y.

ARE YOU GETTING the MOST for YOUR MONEY?

Consider these* LOW PRICED *Seamless and Fabricated

VULCANIZED FIBRE WELDING HELMETS

460-4-C – Straight front for extra chest and throat protection; with Inner Bib for added light and fume seal; seamless; lift-front glassholder.

666-P9 – Fabricated with flat sides, narrow, compact (preferred by Western weldors); light and comfortable; leakproofed seams; 668-P9 has lift-front glassholder.

270-4-C – Seamless; curved bottom to exclude fumes and light; comfortable free-floating headgear with Ratchet adjustment; fixed-front glassholder.

Inner Bib – Straight front shells give increased neck and chest protection. Available with this Inner Bib for added light and fume seal!

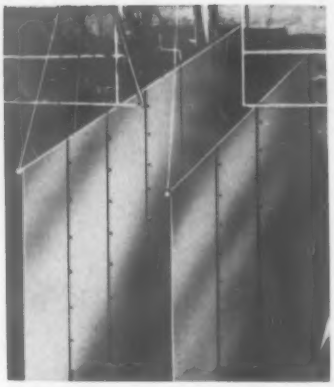
Noted for comfort and safety, these FIBRE-METAL Helmets are formed and fabricated from finest quality, full gauge vulcanized fibre. They "seal" the weldor against light leakage and afford fullest ventilation.

All helmets have Ratchet Adjustment *"free floating"* Headgear, impact resistant adjustable friction joints and adjustable chin rest. Glassholders are available in plastic, steel or Dowmetal, in either fixed-front or lift-front styles.

All types and models of FIBRE-METAL Welding Helmets are described in Catalog No. 26. **Ask your Welding & Safety Distributor!**

The FIBRE-METAL Products Company | CHESTER PENNA.

In CANADA: Fibre-Metal (Canada) Limited, Toronto



Anti-heat cloth

Ray-Foil cloth, consisting of aluminum sheet foil laminated on glass cloth fabric, reflects heat, can be used as a curtain, shield or panel. As a curtain, product is available in 36 in. widths, with panels buttoning together to make any length or height desired. All four sides of curtain have eyelets, and portable frames for them are available. *Frommelt Industries.*

Circle No. 17

Coated abrasives

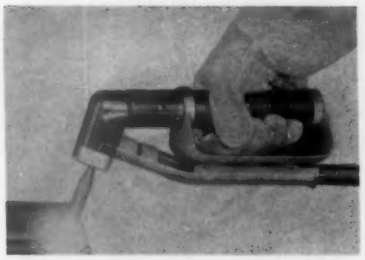
Up to 200% longer life, 2 to 4 times greater particle density, and more efficient cutting are features claimed for coated abrasive discs produced by patented process known as Magnecoating. Feature of process is magnetic orientation of particles so that they are embedded in adhesive coating with sharpest points upwards. Discs are coated after cutting, so that no weakness or damaged coating towards perimeter of disc is caused by die-cutting of the abrasive surface. Rolled edge which results also provides additional abrasive surface. Discs are available in standard grits for all metal, wood and ceramic finishing operations. *Abrasives Co. of America.*

Circle No. 18

Cold pressure welder

Cold pressure welding tool requiring no current, heat or fluxes is available in hand operated bench model. Physical and electrical properties of joint it makes are equal to those of parent metal, manufacturer says. Model KBM 1 will handle .040 in. to .128 in. aluminum wire, and from .040 in. to .114 in. copper wire. Includes rapid die-changing instrument which can also be used for extra die storage. *Koldweld Div., Kelsey-Hayes Co.*

Circle No. 19



Shortstub holder

Model 600 Shortstub electrode holder is designed to completely eliminate electrode holder heating. Operator's hand is kept cool because cable comes close to electrode but does not pass through holder's handle. Aluminum hand guard protects against heat radiated from arc. Model reduces stub losses, says manufacturer, has renewable head, 100% insulation, is rated 600 amp capacity at continuous operation and can handle ⅛ to ⅜-in. electrodes. *Bernard Welding Equipment Co.*

Circle No. 20

Non-acid flux

No resin residue is left by hydrazine flux which is non-acid, non-corrosive, non-hygroscopic and permits refluxing. Designed for soldering electrical and electronic equipment, flux vaporizes completely in heat of soldering. No washing is necessary where all fluxed parts are heated to soldering temperature, and copper-base parts prefluxed with hydrazine flux can be stored overnight. Flux can be used with common solders of tin-lead; tin-lead-silver; tin-antimony; tin-silver; fusible alloys containing tin, lead, cadmium, bismuth, antimony, indium; pure tin; pure lead for bonding to copper. *Fairmount Chemical Co.*

Circle No. 21

Steel-hardening compound

Small-size package of steel hardening compound which contains enough material to harden all chisels, drills, etc., in a fully-equipped home workshop, is suited for initial testing of this process by industrial plants. Guaranteed by manufacturer to increase life of machine parts, tools, jigs by 300%. Non-toxic and non-flammable, it can be applied by simple heat-treating operation within a few minutes. By carburizing, nitrizing and chromizing in a single operation, it is said to give mild steel the hardness of high-carbon alloys, leaving inside core tough and non-brittle. *Hard-N-Tuff Corp.*

Circle No. 22

Testing devices

Three measuring instruments have been introduced for analysis of resistance welding. Current potential transformers are used with direct-writing oscillograph for measurement of primary voltage and current and for cycle counting. They can also be used for adjusting controls for up and down slopes. Another lightweight, self-contained cable testing device permits evaluation of percent of conductivity of welding cables. *Control Devices, Inc.*

Circle No. 23

FOR ANY STAINLESS WELDING JOB

Drawalloy
CORPORATION

Stainless Steel Welding Wire

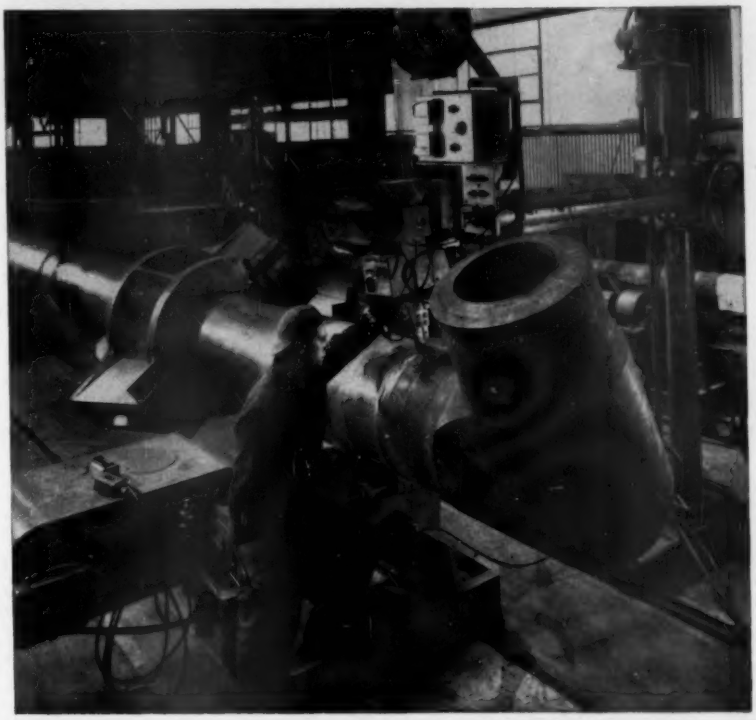
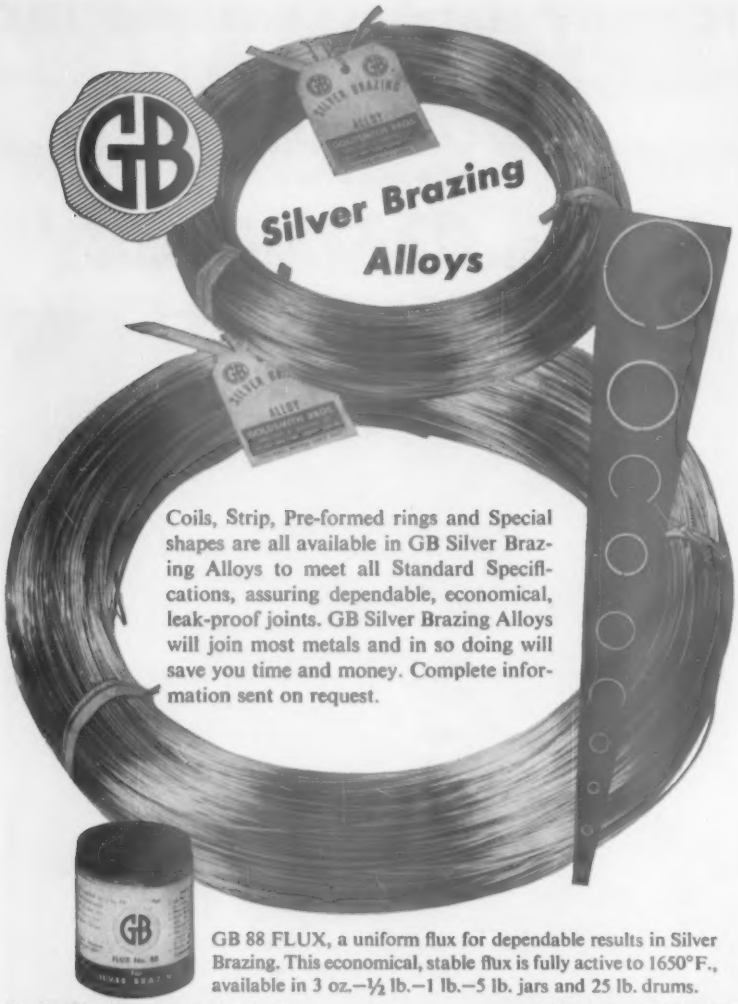


Photo courtesy of National Valve and Manufacturing Co., Pittsburgh, Pa.

Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

DRAWALLOY
CORPORATION
STAINLESS STEEL & TOOL STEEL WELDING WIRE
THE WIRE MILL FOR THE WELDING INDUSTRY


Silver Brazing
Alloys
Coils, Strip, Pre-formed rings and Special shapes are all available in GB Silver Brazing Alloys to meet all Standard Specifications, assuring dependable, economical, leak-proof joints. GB Silver Brazing Alloys will join most metals and in so doing will save you time and money. Complete information sent on request.

GB 88 FLUX, a uniform flux for dependable results in Silver Brazing. This economical, stable flux is fully active to 1650°F., available in 3 oz.–½ lb.–1 lb.–5 lb. jars and 25 lb. drums.

Dealer Distributor Inquiries Invited **Write for GB Data Book**

GB Goldsmith Bros. SMELTING & REFINING CO. Est. 1867

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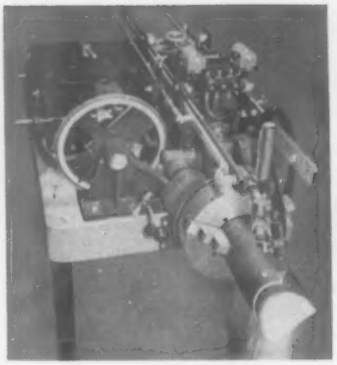
HAVE YOU INVESTIGATED THE POSSIBILITIES OF LOWERING YOUR METAL JOINING COSTS BY SWITCHING TO SILVER BRAZING ALLOY ?



Contour cutter

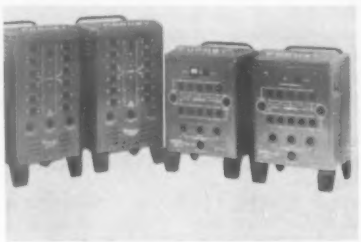
Contour-cutting machine is reported to save up to 75% in time and material for joining pipe and fabricated parts. Designed to practically eliminate use of forged fittings, initial set-up takes as little as 15 sec. Cutting at rate of 20 ipm, a 6-in. aluminum pipe can be contoured in 20 sec. Pipe is clamped into 3-jaw chuck and pertinent information fed into controlling mechanism. Push-button starts automatic cutting action, which proceeds without templates, layouts or patterns. Cutting head is equipped with oxyacetylene torch for cutting carbon steel or Tig torch for cutting aluminum, stainless steel, copper, cast iron, magnesium or high alloy steels. *Steffan Mfg. Corp.*

Circle No. 24

Ceramic

High-temperature ceramic which can be readily machined by user with no further firing required, is now available as rods, discs and custom shapes. Suitable to 2200 F, grade HT-2-M has a low thermal expansion rate which withstands rapid temperature changes without cracking or spalling. It can be machined on conventional machine shop equipment using carbide tipped tools. *Duramic Products, Inc.*

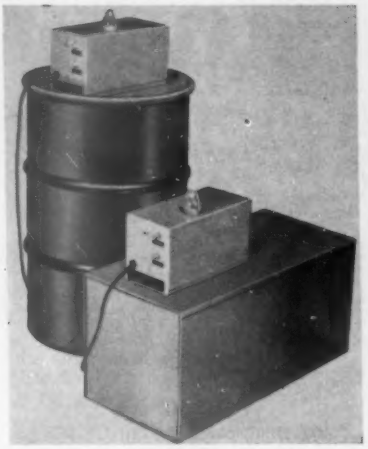
Circle No. 25



Arc welders

Eight different models of a-c arc welders range in size from 5 to 80 amp F-100 welder with six heat stages, to the 5 to 350 amp Model I heavy service unit with 36 heat stages. Welders are waterproofed and insulated for outdoor or indoor service. They accommodate electrodes from 1/16 in. to 1/4 in. diameter, in types designed for welding of cast iron, mild steel, high carbon steel, stainless alloy, aluminum, etc. All models carry unconditional guarantee plus service warrantee for additional eight years. *Forney Arc Welders, Inc.*

Circle No. 26



Equipment Cooler

Bernard 400 series is a new line of cooler-circulators designed to cool inert-arc torches, automatic welding equipment, spot and induction welding equipment and welding fixture back-up bars. Heart of all systems is the Model 400 motor pump control unit, a self-contained package containing motor, bronze-stainless gear pump, by-pass pressure control valve and visible flow indicator. Remote control relay is optional. Unit has a 6 qt capacity minimum at 20-100 psi. *Bernard Welding Equipment Co.*

Circle No. 27

Ultrasonic cleaners

Custom-fitted to operate at peak efficiency over a wide range of applications, ultrasonic cleaner line features modular design and high temperature ceramic transducers. Tanks and generators can be interchanged to provide a specific unit for a given cleaning problem. Consisting of 13 different cleaners in all, cleaning tanks are available in ½, 2½, 6, 16 and 25-gallon sizes, and generators are preset at 50, 100, 200, 500, 1,000, and 2,000 watts. *Gulton Industries, Inc.*

Circle No. 28

Sawtooth crushers

Laptooth line of sawtooth crushers is assembled from standardized blade, shaft, spacer, housing, drive and cleaner-comb components to achieve extreme ranges of process-adaptability with minimum special design. Pulverizing flux cakes, as in welding electrode coating, crushing refractories and insulations for reconstitution, and sizing scrap for easy disposal, are industry applications. *Robinson Mfg. Co.*

Circle No. 29

Oxygen converters

Liquid-oxygen service converters are for any user of oxygen, nitrogen and argon gas. Model 600, a 60,000 cu ft liquefied gas container, has maximum operating pressure of 245 psi and can deliver gas up to 5,000 cu ft per hour on demand, using automatic valving system. Built-in economizer circuit uses accumulated gas pressure when units are shut down on week-end or vacation periods. No-loss liquefied gas system is available in Model 600. *Ronan and Kunzl, Inc.*

Circle No. 30

ELECTRIC-ARC INC.

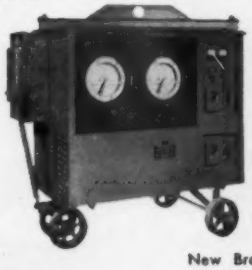
One of a Series on Applications of Electric Arc's Smith-Dolan Units—Today's Most Versatile Heat-Treating Tools.

STOP WELD FAILURE
with the
SMITH-DOLAN SYSTEM
of Low-Frequency Induction Heating

Here is the versatile heat-treating tool you need for producing sound welds easily and economically in carbo-alloy and other types of steel pipe . . . here is precision control of heating cycle when pre-heating and stress relieving — uniform, through-and-through heating of solid sections up to two feet thick and more — pushbutton operation — complete portability for on-the-job heat treating anywhere.

Many Money-Saving Applications — The Smith-Dolan System simplifies and upgrades work quality in numerous applications ranging from welding to forming and annealing. Units are available for 60 cycle heating in capacities ranging from 10 to 150 KVA . . . for 400 cycle heating . . . resistance heating. Pre-engineered with complete instrumentation, accessories.

"On Trial" Installations on Rental Basis — Prove the many Smith-Dolan advantages in your own plant without capital investment. Write, wire or phone.



Electronic recording gives permanent charts of heat run on this standard Smith-Dolan model. Coils permit work at 50 feet or more from unit. Eye hooks provide for easy handling by crane. Products ranging from a fraction of an inch to 10 feet in diameter can be heat treated on the job.

New Brochure — Send today for your copy of "Smith-Dolan System of Low-Frequency Induction Heating."

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THE *NEW* VIEW FOR WELDERS!

WELSH sets the pace in creative design . . . new modern materials and techniques for your more effective eye protection.

Model 1070A — Zephyr

WELSH ZEPHYR — New, increased working visibility . . . greater top ventilation! The first major improvement since the origin of the soft-side. Choice of five ventilation styles.

Model 5070 — Cyclops

WELSH CYCLOPS — A one piece aperture welding goggle . . . soft side frame provides the ultimate in comfort, fit and visibility. Simplified lens holder permits easier changing of filter and cover plates.

Model 5050 — Soft-I

WELSH SOFT-I — Cushion-fit eye protection featuring unique, soft, pliable frame cover goggles. Deep cuts fit easily over largest prescription goggles.

WELSH — *Willingly Worn*

by Workers Everywhere

WELSH

MANUFACTURING COMPANY

9 MAGNOLIA STREET, PROVIDENCE, R. I.

Swing grinder

Small yet powerful, low-cost abrasive belt swing grinder has been developed for contact roll grinding and slack-belt polishing. Model 712 develops 5 hp in constant service on 2½ in. wide belt, 72 in. long. Grinder weighs only 150 lbs with motor, is 46 in. long, 23 in. wide and 14 in. high. Construction is nearly all aluminum. Frame, belt guard, motor mounting pad, starter pad, and hanger bracket are one casting. *Ryman Engr. Co.*

Circle No. 31

Press welder

New standard line of press type resistance welders are available in four sizes ranging from 30 to 500 kva inclusive. Each size is available as a spot welder, a projection welder or a combination spot and projection welder in a range of standard throat depths, electrode forces and transformer sizes. Machines are of slim-line construction said to provide more working area, have anti-friction slides, can be adjusted for wear or take up, and have no covers to remove. Integral transformer and low arm is said to provide maximum power efficiency. Manufacturer says welders are styled to deliver high production runs at low costs. *Federal Machine and Welder Co.*

Circle No. 32

Helmet headgear

Comfortable, durable and easy to attach, according to manufacturer, Fit-Rite nylon headgear is designed so that entire band fits head. Includes rear ratchet knob which adjusts size, and pivoting cross strap which positions on head where it will be most comfortable. Eight holes, four at each end of strap, provide full range of crown-height adjustment. *Flood Safety Prod. Co.*

Circle No. 33

World's Finest CUTTING and WELDING TIP CLEANERS

WYPO

WIPES AND POLISHES

YOU GET SO MUCH MORE IN WYPO *Made of Stainless Steel*

DOUBLES THE LIFE OF YOUR WELDING AND CUTTING TIPS

The exclusive circle design found only in Wypo Cutting and Welding Tip Cleaners provides as many as 60 more cleaning edges per inch of cleaner.

These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

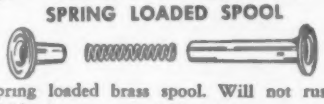
This smooth pilot guides WYPO Tip Cleaner into tip Will not enlarge or damage tip port.

This cross section view of WYPO Cleaning Surfaces shows these exclusive features:

Rounded cleaning surfaces that won't jam or cut.

Straight sided valleys insure thoro cleaning by removing all waste.

SPRING LOADED SPOOL



Spring loaded brass spool. Will not rust. Holds cleaners securely in case.

DOUBLE WOUND EYES

Insures longer life for small sizes of WYPO Tip Cleaners. Will not pull out of case.

NOW AVAILABLE IN 3 CONVENIENT SETS

WYPO TIP CLEANERS

STANDARD SET

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49

MADE IN U.S.A.
PAT. NOS. 2422501, 2473750 IN CANADA 1948

STANDARD SET OF (13) Cleaners (12) Drill Sizes Nos. 75 to 49 Incl.

WYPO TIP CLEANERS

JUMBO SET

CLEANER NO.	FOR DRILL
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
48	30

MADE IN U.S.A.
PAT. NOS. 2422501, 2473750 IN CANADA 1948

JUMBO SET OF (9) Cleaners (19) Drill Sizes Nos. 48 to 30 Incl.

MASTER SET

WYPO TIP CLEANERS

PAT. NOS. 2422501, 2473750 IN CANADA 1948

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
48	30

MADE IN U.S.A.

MASTER SET OF (31) Cleaners (46) Drill Sizes Nos. 75 to 30 Incl.

Replacement cleaners available. Cleaning Range —Cleaner No. & Drill Nos. stamped on back of each case. WYPO GIVES YOU MORE!

SOLD BY LEADING WELDING SUPPLY DEALERS

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L. L. McBurney

apolis, succeeds Dr. H. S. Sutherland, president of Shawinigan Chemicals Ltd., Montreal.

During the two-day meet, John R. Callaham, editor of *Chemical Engineering*, predicted that the New Orleans area would be, within a decade, one of the leading chemical complexes in the United States.

At the opening day luncheon, councilman-at-large Glenn P. Clasen presented certificates of honorary citizenship and symbolic keys to the City of New Orleans to Dr. Sutherland and Callaham.

A highlight of the convention was the presentation of the James Turner Morehead Medal to Stanley B. Kirk, former president of Linde Co. (See WELDING ENGINEER, March, p. 62).

During the meet, C. F. Bonnet, plant manager of the Fortier plant of the American Cyanamid Co., New Orleans, discussed "Acetylene as a raw chemical material."

A panel presented views on the safe uses of oxyacetylene processes and equipment. Participating on the panel were A. F. Chouinard, National Cylinder Gas Div., Chicago; F. C. Saacke, Air Reduction Co., Inc., New York City; Clark Jones, National Fire Protection Association, Boston; W. R. Smith, Kaiser Aluminum & Chemical Sales Corp., Chalmette, La.; and Prof. G. I. Cambre, School of Mechanical Engineering, Louisiana State University, Baton Rouge, La.

Airco oxygen plant completed at Denver

Air Reduction Sales Co., New York City, has completed construction of an oxygen and nitrogen plant at Denver, Colo. William O. Brown is in charge of all company operations at Denver. Leo C. Jones is superintendent of the new facility.

Savings in reclaimed flux alone have paid for Invincible units in a few months, or even weeks, on submerged arc welding jobs.

INVINCIBLE
Welding Flux Recovery Systems
MAKE 3-WAY SAVINGS

1 *Valuable Flux Reclaimed. Automatic* Invincibles recover *all* unfused flux and return slag-free, dust-free usable flux to the welder—*all in one continuous operation.*

2 *Costly Man-Hours Saved.* Invincibles do the complete job automatically—far more swiftly and efficiently than manual methods.

3 *Fewer Expensive Rejects.* Invincibles remove all fine dust (flux flour), thus reducing welding rejects and speeding production.

Many Important Advantages

- Ruggedly built to resist abrasive nature of flux.
- Compact and lightweight. Variety of models and flexibility eliminate need for tailor-made installations.
- Portable units also available.

Operating continuously, this Invincible recovers all unfused flux from pipe-seam welding operation at a leading automotive firm.

WRITE TODAY FOR FOLDER on Invincible Flux Recovery Systems.

INVINCIBLE VACUUM CLEANER MFG. CO.
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BRIGHT FINISH
ALUMINUM
WELDING WIRE
• deposits uniformly
• eliminates interruptions
• makes x-ray quality welds

All-State Bright Wire Spoolarc, extruded and precision spooled, is uniformly round, microscopically clean . . . meets aviation, tankage, and shipbuilding standards.

Send for booklet and chart on all types and forms of aluminum in BRIGHT FINISH . . . including 1 lb. and 10 lb. spools. Stock maintained at St. Louis, South Gate, Calif., Toronto, Canada, and White Plains, N. Y.

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THE NEWEST
PORTABLE
SPOT WELDER

Merit
Might
Midget

Completely new . . . and engineered for today's production demands . . . the Merit Might Midget is the perfect answer to all your welding problems.

- Trouble-free electronic timer and contactor
- Welds up to 3/16" combined thickness
- Uses standard #1 Morse taper tips
- Variable tip pressure—0 to 1000 lbs. in seconds
- Available in 2 models; Water-cooled or Air-cooled

For additional information, ask your jobber or write: The Merit Company, 2124 W. Chicago Ave., Chicago 22, Ill.

Sold through jobbers only
Contact:
SPOT WELDER DIVISION
THE MERIT COMPANY
2124 W. Chicago Avenue
Chicago 22, Illinois

Ultrasonic inspection school conducted by Sperry Products

Sperry Products Inc., Danbury, Mass., recently conducted a school organized to meet the need for a better understanding of ultrasonics and its many inspection possibilities.

Among the companies represented at the session were Westinghouse Electric, Babcock & Wilcox, Bethlehem Steel, Republic Aviation Corp. and Lycoming Div. of Avco.

Vitro contracted to study Strato-Lab

Vitro Laboratories, Silver Springs, Md., has been awarded a contract by the Office of Naval Research to conduct a study of Strato-Lab, a manned stratosphere laboratory.

The laboratory will be on a platform suspended from a high-altitude balloon 100,000 to 120,000 ft above Earth's surface. Strato-Lab scientists will do research in the pure sciences and seek ways to adapt the laboratory to communications and weather prediction uses.

Name change for American Hose

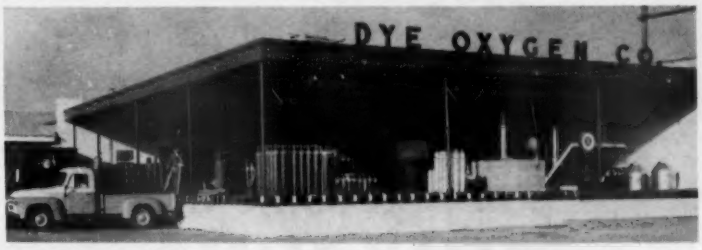
The name of American Metal Hose Div. of The American Brass Co., Waterbury, Conn., has been changed to Anaconda Metal Hose Div.

Mile of pipe for jets

AN underground network of nearly a mile of aluminum pipeline will be used at Atlanta Municipal Airport to supply Delta Air Lines' DC-8 jets with JP-4 fuel. Each of 24 systems was assembled and Mig welded above ground. Coated and wrapped lines were lowered into trenches by cranes. Each installation required 117 ft of 6-in. and 78 ft of 4-in. pipe. Aluminum was used because it does not react with aviation fuel to form gum or sludge. Aluminum Co. of America supplied the pipe.

Curtain-wall building

ARTIST'S conception of new 30-story office building being built by Uris Brothers in downtown Manhattan. Building will be largest curtain-wall structure in world with 350,000 sq ft of the aluminum material. The story appearing in the April issue implied that Michael Flynn Mfg. Co. was constructing the entire building. However, the firm actually was the contractor for fabricating and installing only the curtain wall.



FIRST of four-part, two-year expansion program of Dye Oxygen Co., Phoenix, Ariz. Facility includes loading dock complete with cylinder painting and servicing apparatus, as well as dry ice and CO_2 department. Second phase of program, $30,000 office building, is expected to be completed this month. Other portions of the program include construction of 17 ton liquid oxygen plant and liquid oxygen and nitrogen storage tanks at points throughout state.

Giant radiograph machine installed by Cooper Alloy

Cooper Alloy Corp., Hillside, N. J., has put into operation Cyclops, said to be the highest-capacity radioisotope machine ever installed in the United States. Manufactured by the Picker-X-Ray Corp., White Plains, N. Y., the unit can X-ray up to a 12-in. thickness of steel.

Sourcehead of Cyclops, which resembles a giant one-eyed diving helmet, is capable of handling a Cobalt 60 source of 1,500 curies. This will produce radiographs that previously could only be obtained with X-ray machines in the 2,000,000 to 3,000,000-volt range.

Lehigh University receives three grants

A $4,500 scholarship grant for its fellowship program has been given to Lehigh University, Bethlehem, Pa. by Linde Co. Gordon Foundation Inc. has given the university $1,500 for a graduate fellowship in metallurgy, and the American Society for Metals has given $500 for education and research.

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Lukens contracted for extra-large steel sheet

Lukens Steel Co., Coatesville, Pa., has been awarded a Navy Department contract to do research and development work in the production of high-strength steel sheet of record-breaking size for rocket engine casings.

Lukens' specific assignment is to develop the widest possible sheet that meets the quality requirements of rocket engine service, yet can be produced at a minimum expense.

Maximum width is desired because it will reduce the number of weld seams needed to make rocket engine casings.

Lukens states that it has already produced the world's largest sheet of high strength steel, an experimental product measuring 160 by 192 in.

The contract is part of a broad development program in so-called "second generation" rockets, like the Navy's Polaris missile, using solid fuels.

Diversey licenses Pfizer of Brooklyn

Diversey Corp., Chicago, manufacturer of chemical specialties for metal industries, has given Chas. Pfizer & Co., Inc., Brooklyn, a non-exclusive license under Diversey's U. S. Patent No. 2650875. The patent covers a method of etching aluminum and aluminum base alloys.

Stainless steel welding

PRIMEWELD Corp., Dearborn, Mich., has developed a method of welding stainless steel fasteners to stainless steel stampings without leaving weld marks. Method is being used to fasten stainless trim to automobiles. Primeweld says it uses a transformer emitting low voltage and high amperage to join pieces. Steel which can be joined by process can be between 0.090 and 0.022 gage. Stainless parts used in Primewelding are supplied by Allegheny Ludlum Steel Corp.

West coast subsidiary formed by Fibre-Metal

Another subsidiary company has been organized by Fibre-Metal Products Co., Chester, Pa. Fibre-Metal Pacific, Inc., will warehouse and wholesale welding accessories and safety equipment in seven western states—California, Washington, Oregon, Idaho, Nevada, Utah and Arizona.

Located at 7332 S. Garfield Ave., Bell Gardens, Calif., the new firm will sell exclusively to welding and safety supply distributors. it will also handle products of Glendale Optical Co. and J. M. Ragle Industries.

H. V. (Vern) Gates, formerly with Jackson Products, has been appointed general manager and will be an officer of the new firm.

Cottet's incorporated in New York state

Cottet's Welding Supply Co., Syracuse, recently incorporated under the laws of New York state. DeAlton and Arthur Cottet, and Frank Fudesco are officers and stockholders of the corporation.

Pipeline News

The Federal Power Commission has authorized Michigan Wisconsin Pipe Line Co., Detroit, to construct natural gas facilities costing $3,000,000, with no single project to cost more than $500,000.

Permission has been given Texas Gas Transmission Corp., Owensboro, Ky., to build $3,000,000 worth of natural gas facilities. Under the budget-type proposal, Texas Gas cannot build any project costing more than $400,000.

Transcontinental Gas Pipe Line Corp., Houston, can build facilities costing $2,135,000 says FPC. The project includes construction of three laterals. Two 16-in. laterals, one 13 miles long the other 1.8 miles long, will be constructed, and one 12-in. line 0.71 miles long will be laid.

Tennessee Gas Transmission Co., Houston, will increase its average system delivery capacity by 405,599,000 cu ft of natural gas a day at a cost of $169,329,000. The project includes construction of 1,072 miles of pipe line and the addition of 104,250 hp in compressor capacity.

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Of Connecting Welding Cable

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*THREADED POWER CONNECTION

Trim insulation — allow ¼" to extend through sleeve

Slip on threaded sleeve

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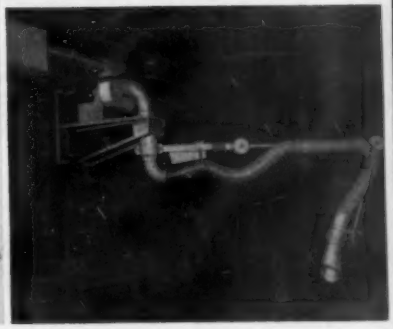

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- Systems have been approved for Government Health Depts. in U. S. & Canada.
- Guaranteed for highest efficiency.
- Portable & Stationary units for all applications.
- Unlimited flexibility; fast, easy positioning over 360°.
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- Engwald Exhausters come complete with mounting brackets.

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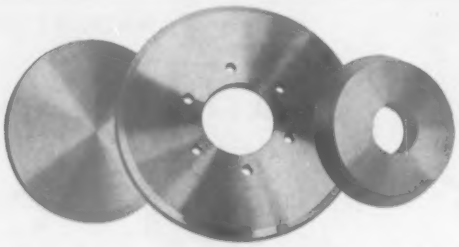

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Seam Welding Wheels are finished to your specifications or supplied as rough forgings; consult the TUFFALOY stock list for sizes immediately available. Replaceable rings are often economical to retread larger or water-cooled wheels.

Special Tuffaloy Parts, such as the two dies and the seam welding shaft shown here, are other examples of what TUFFALOY means to you in *quality* alloys, *precision* machining, *prompt* service.

Tuffaloy resistance welding alloy products are widely available through Airco and Tuffaloy representatives. Call on them for SPOTWELDING TIPS (Standard, 'Tuffcap', Cold-Bent, and Special), Holders and Adapters, BAR STOCK, FORGINGS, SEAM WELDING WHEELS, and all other welding alloy needs. Ask for Catalog and Price List.

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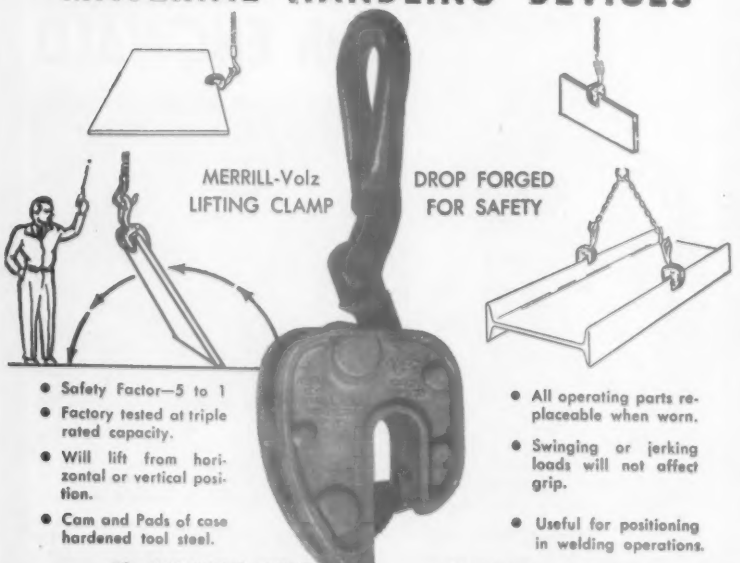

- Safety Factor—5 to 1
- Factory tested at triple rated capacity.
- Will lift from horizontal or vertical position.
- Cam and Pads of case hardened tool steel.
- All operating parts replaceable when worn.
- Swinging or jerking loads will not affect grip.
- Useful for positioning in welding operations.

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MERRILL BROTHERS

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Ruptic

Whitlow

A. O. Smith Corp., Milwaukee, has named *J. C. Ruptic* sales manager in six Illinois counties: Kane, LaSalle, Kendall, DuPage, Grundy and part of Cook.

Responsibility for the export sale of all welding equipment of Hobart Bros. Co., Troy, O., has been taken over by *G. R. Whitlow*, new manager of the export division. He succeeds *W. J. Chaffee*, now director of the statistical department.

About people . . .

All-State Welding Alloys Co., Inc., White Plains, N. Y., recently appointed two special salesmen to handle air conditioning and refrigeration accounts in the East. *Allen B. Harvey*, member of the American Society of Refrigeration for 15 years, and *Tony DeChiara*, former sales manager of Drico Industrial Corp., are the new representatives.

Harnischfeger Corp., Milwaukee, has named *Hardwick L. Browne* sales manager of welding products sold by the company's International Division.

Ed Still is new sales representative in the San Francisco District for Linde Co., New York City. Also, *Laurence H. Kissler* was appointed supervisor of distributor sales in the Salt Lake City District.

Acting chief engineer of Wheelabrator Corp., *Harold F. Schulte*, has been appointed chief engineer of the Mishawaka, Ind., firm.

Cardox Div. of Chemetron Corp. has named seven regional managers for carbon dioxide: *Edward Schneider*, East; *R. C. Wothe*, Mid-central; *H. E. Butler*, Southern; *Herbert Towner*, Midwest; *Alvin Groppe*, Central; *Otis Brightwell*, Southwest; *Paul F. Droste*, Pacific.

Jeffers

Chamberlain

William R. Jeffers has been named sales manager of General Dynamics Corp.'s Cincinnati District.

R. N. (Ron) Chamberlain has joined the sales staff of Fibre-Metal Midwest Inc., Chicago. He will cover the north-central states.

Alloy Rods Co., York, Pa., has named five new field representatives. All the men recently completed the company's six-month training program. They are: *E. F. Weisser,* Philadelphia; *F. J. Rex, Jr.,* Pittsburgh; *R. M. Alexander,* Chicago; *R. F. Mann,* Chicago; *W. E. Spangler,* Houston.

Smith Welding Equipment Corp., Minneapolis, has named *Harold Mendenhall* technical sales engineer in the sales department.

E. R. Humann, president of Airco Co. International, has been named director of purchases of the parent organization, Air Reduction Co., Inc. *J. G. Bell,* International's sales manager, succeeds Humann as president.

The board of directors of the Westinghouse Electric Corp., Pittsburgh, has elected *Mark W. Cresap, Jr.,* president and chief executive officer of the firm. *Gwilym A. Price* was elected chairman of the board.

Charles T. Smith is the new assistant marketing manager of Babcock & Wilcox Co.'s Boiler Div. He succeeds *William H. Jackson,* who was elected vice president in charge of sales of the Diamond Power Specialty Corp., Lancaster, O.

Leonard W. Mawhinney has been named executive advisor to the president of Metal & Thermit Corp., *H. E. Martin.* Mawhinney will headquarter in New York City.

Jerry D. Hix has been appointed to the newly created post of metallurgical product sales manager by the Chemical & Metallurgical Div. of Sylvania Electric Products Inc., New York City. He will headquarter in Towanda, Pa.

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CATHODICALLY!
USE DRYGALV
ZINC COATING

DRYGALV coating is 95% metallic zinc:

- stops rust on iron and steel—permanently
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Use DRYGALV and end rust worries for good! Only a minimum of surface preparation is necessary. DRYGALV can be applied over rust, partially painted surfaces or clean metal. It dries to the touch in 15-30 minutes, can be painted over in only 8 hours where color is desired. DRYGALV is non-toxic; protects against the effects of sea water. *It is applied by brush or spray.*

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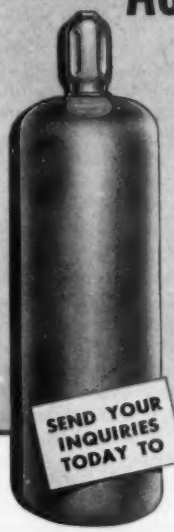
Acetylene Cylinders



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ANY Pipe Joint or Structural Angle Cut NOW Layed Out in Just MINUTES!

- Marks off easily and accurately any pipe joint.
- Eliminates all figuring of cut backs, and marks all around pipe.
- Saves man-hours, as well as oxygen and acetylene gas.
- Makes it easy to mark off end of lateral pipe.

NO MISTAKES — NO TIME LOSS

—regardless of the type or size of pipe joint to be welded. No more "cut and try" with a **CONTOUR MARKER** — it eliminates the need for calculation, and is available in 2 sizes for marking pipe and structurals of 1½" to 18" in cross section, and from 16" to 48" diameter. Send for complete description.

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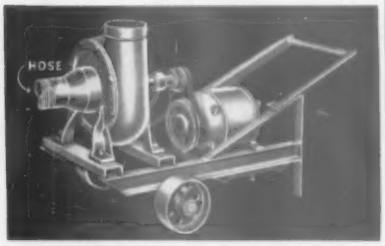
THE CONTOUR MARKER

RUEMELIN *Portable*
Fume Collector

Removes gas, smoke and heat from welding operations. Recommended for ventilation of tank interiors, manholes, vats, airplane fuselages or for blowing fresh air into inaccessible places.



• Collector is equipped with a power unit capable of handling up to 35 ft. of steel tubing. Mounted on rubber tired wheels for ease of handling. Models also available mounted on steel legs for hose operation in a complete 360 degree circle.

• This view shows inlet hood picking up welding smoke. Operator breathing zone protected.

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Manufacturers and Engineers • Sand Blast and Dust Collecting Equipment • Welding Fume Collectors

Richard Y. Neiley has joined Sperry Products Inc., Danbury, Conn., as assistant industrial sales manager.

Neiley

Wooding

Walter H. Wooding has joined the research and development department of Arcos Corp., Philadelphia.

The board of directors of Mid-State Welder Mfg. Co., Chicago, elected *George W. Cross* vice president of operations, and *Otto E. Fenske, Jr.*, vice president of sales.

Pfaudler Co., Rochester, has appointed *Lawrence C. Rodgers, Jr.*, product manager, special metals fabrication. He will be responsible for the sale of titanium, tantalum and zirconium equipment.

New factory manager in charge of manufacturing at Vard Inc., Pasadena subsidiary of Royal Industries Inc., is *Paul F. Bruning.*

Duane R. Branka is the new general sales manager of the Sinclair-Collins Valve Co., and Valvair Corp., divisions of the International Basic Economy Corp. Branaka succeeds *Jack M. Partridge* who has been named manager of Valvair's Cleveland sales office.

J. G. Willis is manager of manufacturing of Blaw-Knox Co.'s equipment division in Blawnox, Pa. He is a member of the American Welding Society.

Climax Molybdenum Co., Div. of American Metal Climax Inc., New York City, has made three appointments. *Walter F. Craig, Jr.*, has been appointed manager of metallurgical development. Working from a New York City office, he will head a staff of engineers who provide assistance to users of molybdenum-containing metal. *Fred W. Ellis* is the new foundry sales representative to the Dayton, O., area. He replaces the late *Mr. H. Geitmann. John L. Goheen* has been named assistant manager of the company's Los Angeles office, and will service foundry customers.

Thomas J. Cunningham will represent OKI Welding Equipment Co., Cincinnati, in north-western Ohio.

Cunningham

Long

New president of Taylor-Winfield Corp., Warren, O., is *T. S. Long.* He succeeds *J. Denton Anderson*, who became chairman of the board and chief executive officer of the firm.

Gerald J. Shoskey has rejoined Saginaw Welding Supply Co., Saginaw, Mich., as a sales representative after four years in the tool and die business.

Dr. Arthur R. Matheson has been appointed manager of the reprocessing division at Sylvania-Corning Corp.'s Bayside facility. He will guide reprocessing activities on spent fuel elements from nuclear reactors.

John H. Matthews, executive vice president, has retired from full general management responsibilities of the Manhattan Rubber Div., Raybestos-Manhattan Inc., Passaic, N. J.

The Young Presidents' Organization, New York City, has elected to its membership the president of Delta Welder Corp., Detroit, *Harry E. Day.*

A. T. Waidelich was elected vice president and director of engineering and research for the Austin Co., Cleveland engineers and builders. He has been with Austin since 1936 and was at one time on the structural engineering faculty of Massachusetts Institute of Technology.

Following the death of *William H. Eisenman* last May, national secretary, the American Society for Metals established a new position, that of managing director. *Allan Ray Putnam* has been named to fill the new post. He is former assistant executive secretary of the American Society of Tool Engineers. He will headquarter in Cleveland.

Died . . .

W. Ralph Stickney, 48, died as a result of a heart attack, March 4. He was chief welding engineer for the Canadian Welding Bureau.

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MITTENS
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BRAZILIAN DEERSKIN THE "STAY SOFT" LEATHER GLOVES AND MITTENS

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When You Weld Cast Iron Select the Correct

Fuse-Well

CAST IRON WELDING RODS OR ELECTRODES

FUSE-WELL NO. 11

FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

FUSE-WELL NO. 12

FUSE-WELL No. 12, *Round*—Has the same uses and analytical ingredients as Fuse-Well No. 11.

FUSE-WELL NO. 14 MOLY

FUSE-WELL No. 14, *Moly*—An Iron Base Rod with alloys added for finer grain structure and greater strength.

FUSE-WELL NO. 22

FUSE-WELL No. 22, *Electrode* — Light coated Rod to be used for AC or DC welding in the fabricating and repairing of cast iron castings.

THE CHICAGO HARDWARE FOUNDRY CO.
Weld Rod Division
NORTH CHICAGO, ILLINOIS

Filler Metals

FILLER METALS FOR JOINING. By Orville T. Barnett. Published by Reinhold Publishing Corp., New York, 1959. Cloth, 6 by 9 in., 244 pages. Price, $7.

Regular readers of WELDING ENGINEER will be happy to learn that Orville Barnett's series on "Filler metals for joining," which appeared in 19 installments in WELDING ENGINEER over the past three years, has now been compiled in book form.

This is the answer to those who have requested tear sheets and reprints of this interesting series which discusses industrial practices in selecting the proper filler metal for any metal joining situation.

The 19 installments have been turned into chapters, nine of which are devoted to arc welding electrodes. One chapter covers automatic welding of mild steel and low alloys and in some instances discusses materials where no AWS specifications yet exist.

The non-ferrous field is covered in chapters on aluminum, copper, nickel and stainless steel. Brazing, soldering and hardfacing, as well as tungsten electrodes for Tig welding, are also discussed.

If the material made good reading in your copy of WELDING ENGINEER, it will now make a valuable addition to your library.

Structural engineering

SIMPLIFIED PROBLEMS IN STRENGTH OF MATERIALS AND STRUCTURAL DESIGN. By Ephraim Viertels. Published by Arco Publishing Co., New York, 1959. Cloth, 636 pages. Price, $5.

This volume is an all-problem work prepared for the structural engineering field for use as either a reference or refresher book.

In its three parts, questions on each subject are presented, then problems on that subject are stated and solved, step-by-step. All questions and the 735 problems are arranged on a theoretical and practical basis, and answers are provided for each problem.

Part I covers simple stresses;

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WHY?

Because—

- There's a type to insure controlled vision for ANY job!
- Costs less per welding foot than ANY other cover lens.
- Being Precision made and shatterproof they last longer and insure against eye strain.
- For over 15 years THERMO has led in sales and usage.

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Really FIVE TOOLS in ONE

Yes, actually a BOYCE Centering Head replaces

- ✓ The Protractor
- ✓ The Centerhead
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Determines Center Line at any Degree and Measures Degree of Declivity

DIAL SET LEVEL

Weighs only 9 ozs. Pocket size.

Y type head accurately machined with tangents and tips for centering and aligning. Dial Set Level in graduations of 2½ and 10 degree markings. Punch of Drill Rod with hardened point—insuring long service. Send for complete description.

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Also Mfgs. of Contour Markers, Radius Markers and Pipe Flange Aligners.

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QUIK HEAT

up to 2200° F.

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BLOWTORCH

Here's a big, efficient blowtorch for all kinds of heat treating and production processes—yet it is completely and easily portable. Operates economically on either natural or manufactured gas. Produces heat up to 2200° F. in seconds! 1/3 h. p., Universal Motor. Sealed, precision ball bearings require no oiling. Equipped with metal stand, 8 ft. of gas hose and 20 ft. of reinforced rubber covered Underwriters' Approved cord with plug.

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INDUSTRIAL PRODUCTS DIVISION

graphic statics; center of gravity; reactions of beams, girders, roof trusses and arches; shear and shear diagrams; bending moment and moment diagrams; influence lines and torsion.

Part II discusses welding and welded connections; elements of theory of bending; movement of inertia; design of steel and wooden beams; floor design; rivets and riveted connections.

Part III includes design of plate girders, columns, bearing plates and roof trusses.

The publisher says students, architects and engineers will find the book helpful in preparing for state license examinations.

Grinding wheels

THE GRINDING WHEEL. Revised by William F. Schleicher. Published by The Grinding Wheel Institute, Cleveland, 1959. Cloth, 532 pages. Price, $4.95.

Originally published in 1951, *The Grinding Wheel* has been completely revised and updated. It discusses wheels, machines and operations from a basic, as well as a practical, working standpoint.

The book's 32 chapters examine abrasive materials, wheel shapes and sizes, bond and wheel manufacture. The entire range of abrasive operations covers not only metalworking, which comprises the book's bulk, but the grinding of ceramics, glass, marble and concrete.

Special chapters deal with the evaluation of surface quality, truing and dressing, grinding fluids, and factors affecting wheel selection. The practical aspect has been stressed throughout the book, with many hints for efficient grinding, wheel selection and trouble shooting.

Among the new chapters incorporated in the revised edition are jig grinding, electro-assist grinding, optical projection grinding, filtering of grinding fluids, and grinding of ceramics. Automatic sizing, loading and unloading, and man-made diamonds are briefly examined.

One of the most valuable sections of the book is a trouble shooting chart and wheel selection chart. The majority of troubles encountered by the grinding operator, and the remedy for these troubles, are discussed. The 16-page wheel selection chart gives wheel recommendations for every major kind of material from agate to wrought iron.

A special chapter on safety is included in this edition, rather than being part of the appendix, as in the original book.

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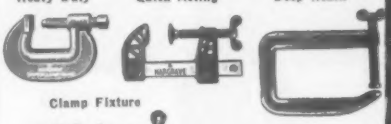
Welders Clamps

Spring Clamp | Std. Carriage | Forged Steel

Heavy Duty | Quick Acting | Deep Reach



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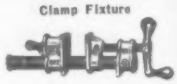

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51. ELECTROSLAG WELDER—Amalgamated Industrial Corp. Vertomatic, the European made machine utilizing Electroslag process to weld heavy plate in vertical position, is detailed in booklet.

52. PLASMA ARC PLATING—Linde Co. Company's plasma arc plating service, the coating and fabricating of shapes using ultra-hard materials, is described in pamphlet.

53. ALUMINUM MAINTENANCE—Aluminum Co. of America. "Manual for maintenance and damage repair of aluminum tank trailers," is designed to aid welding shop which must work on light metal transport rigs.

54. TIG TORCH—Wilson Welding Equipment. Tig torch that provides from 5 to 150 amp for work on boilers, heat exchangers, screens, etc., is described in brochure.

55. ELECTRICAL CONNECTIONS—Erico Products Inc. Company's complete line of electrical connections and accessories is detailed and pictured in 104-page catalog.

56. COMPOSITE BEAMS—KSM Products Inc. "Composite beams with stud shear connectors," is a reprint containing illustrations, charts and graphs.

57. SEAMER—Cayuga Machine & Fabricating Co., Inc. Flyer describes advantages of portable seamer available with tracks from 5 to 20 ft long.

58. TURNING ROLLS—Pandjiris Weldment Co. Complete turning roll specifications for various rolls are included in bulletin 1257 R.

59. LOW HYDROGEN ELECTRODES—Champion Rivet Co. Low hydrogen electrodes for fabrication of chrome-moly steels are covered in bulletin 57B.

60. SPOT WELDING—Tec Torch Co., Inc. Requirements for Tig spot welding with company's torch are given in flyer.

61. CONTROL PANELS—Oilgear Co. Bulletin 36400 illustrates different forms of amplifier and control panels built by company for operating electrohydraulic servo system.

62. TEMPERATURE INDICATING PIGMENTS—Curtiss-Wright Corp. Flyer describes single and multi-color temperature indicating pigments, and provides figures to show their accuracy.

63. GAS LIQUEFIER ECONOMICS—Philips Electronics Inc. Paper G-6 discusses recondensing oxygen vapors, recovery of argon vapors, recovery of flash gases from hydrocarbons and separation processes.

64. MATERIALS DISPENSING—National Cylinder Gas Div. Use of company's solid materials dispensing unit in treatment of molten metals is described in information report No. 17.

65. MACHINE TOOL — Sheffield Corp. Specifications and optional equipment are given in flyer on Model 1000-B-3 machine tool which includes 1,000 watt generator, three-point mounted transducer, abrasive work chuck and hoses.

66. WELDING FITTINGS—Oxo Welding Equipment Co. Hose, regulator and cylinder fittings for use when welding are described in wholesale price catalog 259.

67. CLAMPS—Chicago Boiler Co. Red Head welding clamps are pictured and detailed in flyer.

68. NIBBLER—Fenway Machine Co., Inc. Fenway Portable Nibbler for cutting corrugated steel without distortion, and attachments for cutting circles, etc., is illustrated in brochure.

69. SOLDERS—General Finding & Supply Co. Selection, classification, and available forms of company's solders are included in technical data sheet 501.

70. SAFETY EQUIPMENT—W. H. Mahneke. Safety helmets, face shields and special welding helmets are illustrated in pamphlet.

71. CATALOG INDEX—Bausch & Lomb Optical Co. *Optical Products* is an illustrated index of all current company catalogs. It is divided into three classifications to aid customer selection of desired information.

72. HEAT RESISTANT ALLOY—Rolled Alloys Inc. Bulletin 107 presents latest data on RA330 heat resisting alloy. Design stresses are included.

73. TEMPERATURE INDICATORS—Tempil Corp. Pamphlet 589 covers latest additions to line of temperature indicators—for 331 F and 344 F.

74. STARTER ENCLOSURES—Square D Co. Bulletin 2510 describes company's enclosures for manual starters. New lock-off device is explained.

75. ELECTRIC FURNACE—Thermo Electric Mfg. Co. Type 2100 Thermolyne furnace for laboratory or industrial use is covered in bulletin F-211.

76. TEST FIXTURE—P. A. Sturtevant Co. Fixture for use when testing strength of welded joints is explained in brochure.

77. SAFETY GLASSES—American Optical Co. Advantages and special features of F9700 safety glasses are given in booklet S-6761.

78. DISTRIBUTION SYSTEMS—Whitney Blake Co. Heavy-duty portable distribution systems for electric lighting and power are detailed in Tuffline Div. catalog.

79. MAGNETIC INSPECTION—Ferro Machine & Tool Corp. Specifications and uses of Model P-K Ferroflux portable magnetic inspection unit, which can be used in all types of metal fabrication, are given in data sheet.

80. HARDFACING—A. O. Smith Corp. A new hardfacing electrode catalog, No. MW-222, outlines data on 25 different electrodes and wires.

81. COMPRESSOR PLANT — Ingersoll-Rand. Tendamatic, company's automatic compressor plant system, is covered in pamphlet.

82. REGULATORS — Liquid Carbonic. Standard and heavy duty two stage regulators, and smaller one stage regulators, are detailed in colored brochure.

83. HARDFACING WELDER—Wall Colmonoy Corp. Brochure SA-400 points out and illustrates construction features of welder, and lists variety of applications it can be put to.

84. CLAMPS—Saxton Mfg. Co. Kant-Twist clamps are illustrated and specification chart reproduced on catalog sheet.

85. CYLINDER HISTORY—Miller Fluid Power Div. History and special features of present air and hydraulic cylinders are presented in booklet.

86. GRINDING—Blanchard Machine Co. The art of surface grinding using company's special system is explained in 45-page illustrated book.

87. ALUMINUM CONSTRUCTION—Olin Mathieson Chemical Corp. Design information and technical data charts on architectural applications of aluminum is presented in catalog 15-J.

88. PRIMER—Industrial Metal Protectives Inc. Data sheet covers Zincilate 400, a weldable primer used by automotive industry to protect innerfaces of inaccessible areas.

89. SAFETY ACCESSORIES—Kedman Co. Welding helmets, face shields, welding goggles, eyeshields, gloves and shop caps are illustrated in H-100.

90. INDUCTION HEATING—Welduction Corp. Induction heating equipment is fully detailed and illustrated in booklet, as is line of fusion welders.

91. FORMING MACHINES—American Pullmax Co., Inc. Universal shearing and forming machines are pictured and specifications given in lg/Am.

92. JACKET-GRIPPERS—Tweco Products Inc. Cable connection supports and jacket-grippers to prevent slippage of welding cables and jackets are shown on flyer.

93. INDUCTION FURNACE—NRC Equipment Corp. Technical data sheet covers features and specifications of 12-lb, tilt-pour model 2551-B vacuum induction furnace.

94. METALS DATA—J. T. Ryerson & Son, Inc. Pocket-size, 256-page manual gives aluminum analyses, characteristics, properties, etc., and similar information on steel.

95. TRANSDUCERS—Gulton Industries Inc. Technical brochure explains Glennite high temperature, piezoelectric ceramic transducers.

96. WRENCH—Petersen Mfg. Co., Inc. Combination Vise-Grip wrench and wire cutter is illustrated in brochure. C-clamps and welding clamps are included.

97. CLEANSER—Merix Chemical Co. Wash concentrate prepares plastics, metals, glass, china, rubber and aircraft bodies for high-lustre painting.

98. POKE WELDER—Pioneer Industries. Brochure shows design features and specifications for Model 300, portable spot welder, useful in welding light-weight parts and tacking metal sheets.

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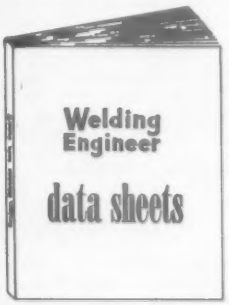

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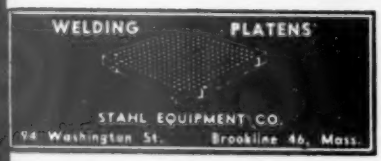

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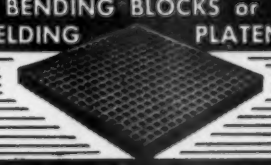

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150. Acro Welder Mfg. Co.—Write for further information on welding machinery, engineered and manufactured to order.

151. Air Reduction Sales Co.—Information available on the new Airco hand cutting and machine cutting torches.

152. Alloy Rods Co.—"Handbook for Welding Low Alloy High Tensile Steels" available.

153. All-State Welding Alloys Co. Inc.—Booklet and chart available on all types and forms of aluminum welding wire.

154. American Brass Co.—Publication B-13 available, giving information on Anaconda welding rods and procedures for welding with copper and copper alloys in a wide variety of applications.

155. American Optical Co.—Write for further information on AO's latest goggles for weldors.

156. American Platinum & Silver Div.—"A Complete Guide To Selective Fluxing For Low Temperature Silver Brazing" is available.

157. American Platinum & Silver Div.—"A Complete Guide To Successful Silver Brazing," also available.

158. American Solder & Flux Co.—Write for further information on "Drygalv" zinc coating to stop rust, and prices.

159. Ampco Metal, Inc.—Catalog and price list of "Ampco-Weld" electrodes available, also name of your nearest distributor.

160. Ansco, Div. of General Aniline & Film Corp.—Further information on Ansco's x-ray films.

161. Arcair Co.—Information on Arcair Torches and special electrodes available.

162. Aronson Machine Co.—Write for more information on the 175 ton capacity welding positioner, the "Excalibur".

163. Atlas Welding Accessories Inc.—Further data available on the Atlas wide-blade "Tomahawks."

164. Bernard Welding Equipment Co.—More information available on the "Short-stub" electrode holder.

165. Cambridge Co.—Write for bulletin CS19 on "Liqua-Guard System" for liquefied atmospheric gases.

166. Cam-Lok Div.—Bulletin No. 301 on the complete line of Receptacles and Plugs is available.

167. Chicago Hardware Foundry Co.—Information on "Fuse-Well" cast-iron welding rods and electrodes available.

168. Cincinnati Tool Co.—Catalog available showing "Hargrave" power tested welders clamps.

169. Clements Mfg. Co.—Bulletins on "Clements Cadillac Model K Blowtorch" available.

170. Contour Marker Corp.—Write for information on laying out pipe joints and establishing and marking a point at any angle.

171. Drawalloy Corp.—Bulletin 355 DC provides complete information on every grade of Drawalloy wire.

172. Electric Arc, Inc.—"Smith-Dolan System of Low-Frequency Induction Heating" available.

173. Engwald Corp.—Write for new catalog WE-5, on Engwald welding fume exhausters.

174. Fibre-Metal Products Co.—Catalog No. 26 describes all types and models of Fibre-Metal welding helmets.

175. Flood Safety Products Co.—Information available on fiber glass helmets and other welding and safety equipment.

176. Goldsmith Brothers Smelting & Refining Co.—Data book on silver brazing available.

177. Harnischfeger Corp.—Bulletin R-29 giving specification data and full description of "P & H" iron powder electrodes.

178. Harrisburg Steel Co.—Write for information on gas cylinders manufactured by Harrisburg.

179. Haynes Stellite Co.—Further information available on Haynes mechanized hard-facing machines and hard-facing alloys.

180. Hobart Brothers Co.—More information on the "Mainliner" welder with gas or diesel engines.

181. Hobart Brothers Co.—Catalog available, "Hobart Welding Electrodes" also sample of the new Hobart 12-A electrode.

182. Independent Engineering Co.—Further information available on acetylene cylinders manufactured by Independent.

183. International Nickel Co.—Booklet giving complete data available, "Repair Cast Iron Parts Quickly and Easily."

184. Invincible Vacuum Cleaner Mfg. Co.—Write for folder on Invincible Flux Recovery Systems.

185. Jackson Products—Further information available on duty-cycle rated holders.

186. K-G Equipment Co., Inc.—Information on complete line of K-G regulators available and name and address of nearest distributor.

187. Lenco, Inc.—Information on connecting welding cable.

188. Lincoln Electric Co.—Bulletin 5200.1 on Lincolnweld automatic submerged arc welding equipment and accessories is available.

189. Lincoln Electric Co.—Bulletin 7000.1, "Weldirectory of Mild Steel Electrodes" for matching the electrode to the job for the most efficient welding.

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NOT GOOD AFTER AUGUST 1, 1959

WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill.

Please send me without obligation further information about the following:

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BUSINESS REPLY CARD

First Class Permit No. 32, Morton Grove, Ill.

Welding Info-Aids,
Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Literature offered in ads

(Continued from page 88)

190. Linde Co.—Write for further information on the new "Sigma ST-2" hand welding torch.

191. Liquid Carbonic Div. General Dynamics Corp.—Write for further information on industrial gases manufactured by Liquid Carbonic.

192. Maitlen And Benson, Inc.—Information on "Wypo" cutting and welding tip cleaners.

193. P. R. Mallory & Co.—Handy wall chart available for your shop, "Do's and Don't's for Resistance Welding."

194. Manhattan Rubber Div.—Further information available on Manhattan portable wheels and other types of high speed, heavy duty abrasive wheels.

195. Merit Co.—Additional information available on "Merit Might Midget", a portable spot welder.

196. Merrill Brothers—Write for further information on material handling devices.

197. Messer Cutting Machines, Inc.—Information on oxygen cutting and automated cutting equipment.

198. Metal & Thermit Corp.—Bulletin available on the "Speedex Triplex" iron powder electrodes.

199. Miller Electric Mfg. Co., Inc.—Complete particulars will be forwarded on Miller's rectifier type welder.

200. National Carbide Co.—Write for further information on calcium carbide and name and address of your nearest distributor.

201. National Welding Equipment Co.—Catalog form 14 available, describes compound pressure cylinder manifold for industrial and medical cylinder gases.

218. Ornamental Iron Co-op—Details on how ornamental iron shops can now purchase supplies on new cooperative plan, saving about 16%.

202. Phoenix Products Co.—"Dry-Rod as Standard Welding Equipment" gives latest rod-drying methods.

203. Pressed Steel Tank Co.—Bulletin "Seamless High Pressure Gas Cylinders" available.

204. Riegel Textile Corp.—Catalog on Riegel gloves available.

205. Ruemelin Mfg. Co.—Write for detailed information on the Ruemelin portable fume collector.

206. Square D Company—Write for further information on a better welding installation, by a Square D field engineer.

207. Stulz-Sickles Co.—Information on "Manganal" semi-automatic wire and name of your nearest distributor.

208. Sylvania Electric Products, Inc.—Further information on Sylvania tungsten electrodes.

209. Tempil Corp.—Information on "Tempilstik" and sample of Tempil pellets available.

210. Thermacote Co.—Write for complete descriptions of "Thermo" filter plates and cover lens.

211. John Tillman & Co.—Write for catalog on weldor's gloves and garments.

212. Tuffaloy Dept.—Catalog and price list on resistance welding alloy products, such as spotwelding tips, holders and adapters.

213. Vickers, Inc., Electric Products Div.—Descriptive bulletins 7136-1 and 7146-1 available on the Vickers "Controlarc" for standard arc welding, constant potential welding and tungsten inert gas welding.

214. Victor Equipment Co.—Further information available on Victor's cutting equipment and regulators.

215. Welsh Mfg. Co.—Write for further information on Welsh's new goggles.

216. Westinghouse Electric Corp.—Further information available on the "RCV" Welding Power source with built in Dynamic Reactor.

217. Worthington Corp.—More information available on Worthington's positioning equipment.

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Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Name_____ Title_____

Company_____

Address_____

City_____ State_____ 5/59

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TIG welding is "right" for so many jobs...

Stainless steel coffee jugs for the Air Force have smooth, high-strength welds produced by TIG welding

All-aluminum water towers feature rugged TIG welding of vertical tank sections

...and Sylvania Tungsten Electrodes do the job right...everytime!

From coffee jugs to aluminum water towers—Tungsten Inert Gas welding is adaptable to almost any job. But the quality of the weld is only as good as the tools you use . . .

That's why TIG welders prefer Sylvania Tungsten Electrodes. You can take your pick of all 4 electrode types: Puretung®, Zirtung®, 2% Thoriated, 1% Thoriated. They're available with cleaned or ground finish. And they're color-coded to prevent waste and costly errors.

Sylvania Tungsten Electrodes—the only complete line—are available through all leading distributors. Call yours today.

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WELDING CLINIC

J. Imperati and R. F. Pulver, Welding Engineers
The American Brass Company, Waterbury, Conn.

Braze Welding of Cast Iron

There are two major obstacles to successful repair welding of cast iron: 1. low-strength and poor ductility of cast-iron weld metal, 2. embrittlement and hardening produced by rapid cooling from fusion-welding temperatures.

Oxyacetylene fusion welds with cast-iron rods have such very low strength and ductility that they often crack under the stresses imposed during welding and cooling. If they survive these hazards, they are likely to fail when subjected to the service stresses that caused the original failures.

Arc welding, because of steep temperature gradients between weld and base metal, is likely to embrittle and harden both weld and adjacent base metal. Here, too, failure may occur during welding and cooling, or later in service. It is usually necessary to resort to carefully controlled schedules of preheating, peening, and post-heating, often with high-cost alloy filler metal, to avoid the twin evils of embrittlement and hardening.

Oxyacetylene braze welding is an excellent solution to the problem for two reasons. With the low temperatures required, there is no rapid cooling from high temperatures and therefore no embrittlement. Excellent ductility and high strength of the weld metal deposited by Tobin Bronze®-481, Anaconda-997 (Low Fuming) Bronze, and Nickel Silver-828, permit yielding while the repairs are being made and after they are returned to service, and the danger of failure is practically eliminated.

The braze-welding operation itself is virtually foolproof because the molten bronze automatically "tins out" or spreads over the joint surfaces when the correct temperature is reached. Since the base metal is not melted, control of the weld metal is very easy and braze welding is readily done in all positions.

ADVANTAGES OF BRAZE WELDING WITH ANACONDA WELDING RODS ARE:

1. Economy in welding time and gas consumption.

2. Development of low residual stresses with less distortion and less tendency to crack.

3. No embrittlement, and complete machinability of the weld areas.

4. Minimum delay in returning the repaired parts to service.

DETAILED INFORMATION AVAILABLE

Detailed suggestions on the methods of chipping grooves, removing oil, positioning the work, and preheating are given in Publication B-13, which gives full information on Anaconda Welding Rods, discusses procedures for welding with copper and copper alloys in a wide variety of applications.

EXTENSIVE BRAZE-WELDING REPAIRS on the frame of this big steam hammer used 1850 lb. of Tobin Bronze Welding Rod — saved six months' production time, for one-fifth of replacement cost.

These are some of the subjects covered: Copper-Alloy Welding Rods in steel sheet metal work, brazing and soldering, resistance welding, surfacing, welding copper alloys to steel, arc welding of copper and copper alloys.

For information on special problems—or for a copy of Publication B-13—write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 5810B

WELDING ROD	APPROX. COMPOSITION, %	APPROX. MELTING POINT	
		Deg. C	Deg. F.
Tobin Bronze-481	59 copper, 40.40 zinc, 0.60 tin	885	1625
Anaconda-997 (Low Fuming) Bronze	57.80 copper, 40.27 zinc, 0.95 tin, 0.85 iron, 0.10 silicon and 0.03 manganese	870	1598
Nickel Silver-828	48.58 copper, 41 zinc, 10.25 nickel, 0.15 silicon, 0.02 phosphorus	930	1706

ANACONDA®
WELDING RODS
Made by
The American Brass Company